AUGUST 1960

Agricultural Engineering

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The Journal of the American Society of Agricultural Engineers

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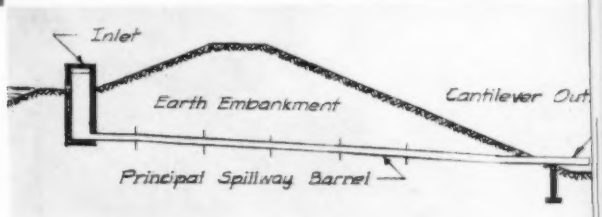

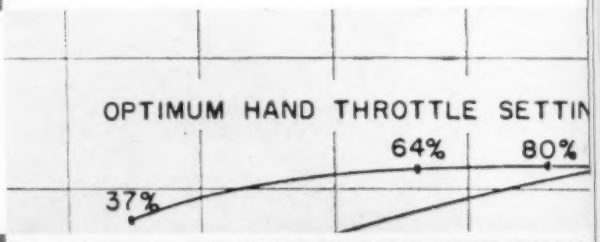

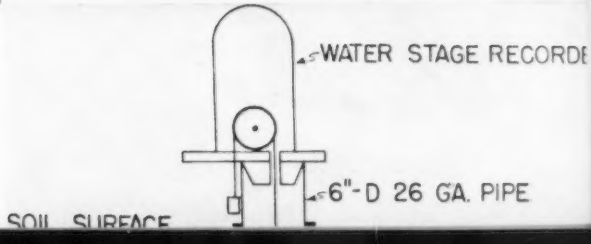

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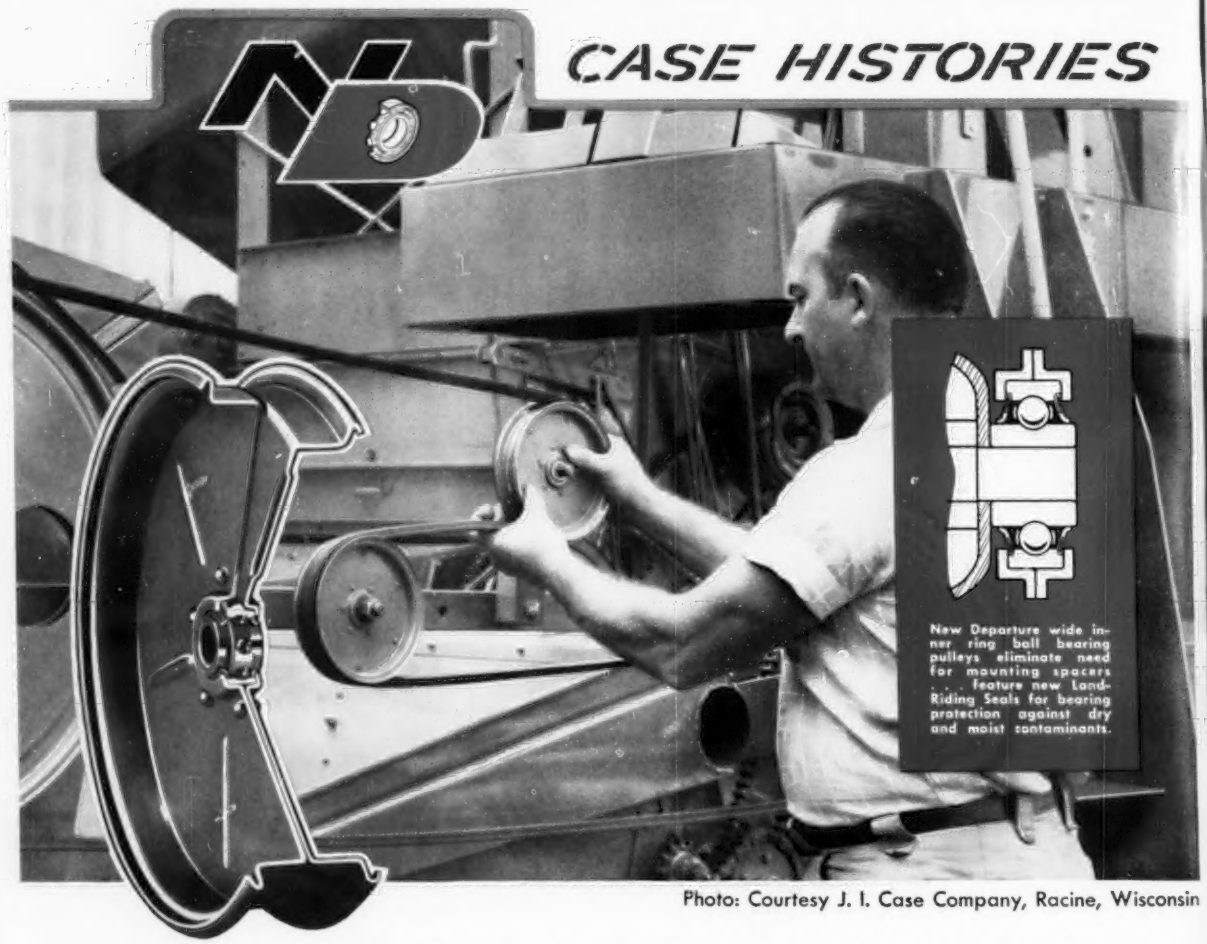

New Departure wide inner ring ball bearing pulleys eliminate need for mounting spacers . . . feature new Land-Riding Seals for bearing protection against dry and moist contaminants.

Photo: Courtesy J. I. Case Company, Racine, Wisconsin

Idler Pulley Assemblies Help Combine Manufacturer Cut Inventory & Assembly Costs!

CUSTOMER PROBLEM:
Leading farm implement manufacturer experiencing rising costs in the installation of ball bearing pulleys on combines and other farm implements.

SOLUTION:
N/D Sales Engineer, in cooperation with the manufacturer, made an evaluation of pulley applications. He then recommended N/D Land-Riding Seal pulley assemblies containing ball bearings with *wide* inner rings. The wide inner ring paved the way to cutting costs by eliminating conventional spacer inventories. Moreover, the manufacturer now enjoys additional savings because N/D Lubricated-for-Life ball bearing pulleys are *fully assembled* at delivery . . . simplifying inventory even more!

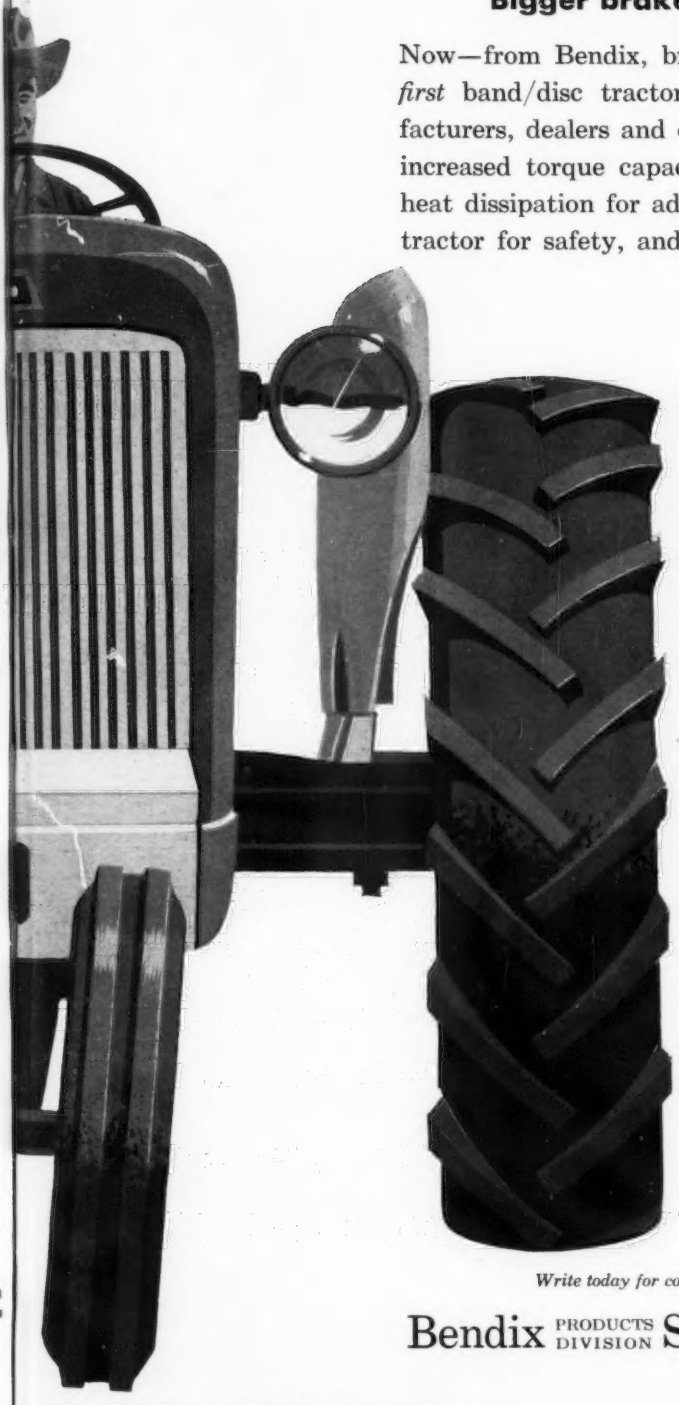
The wide inner ring bearing, butt mounted rigidly against face plate, requires a minimum of parts handling and adjusting at assembly. In addition, these 8" O.D. pulleys have rolled sheave edges for belt protection. All pulleys come with the new and exclusive N/D Land-Riding Seals, factory greased, ready to offer full maintenance-free protection against dry and moist contaminants.

If *you're* a user of flat and "B" section V-Belt pulleys, sizes from 2¾" to 8" O.D., why not check on the savings N/D has to offer? Contact your local N/D Sales Engineer or, write today for the new N/D Idler Pulley Bulletin giving complete specifications and mounting data. New Departure Division, General Motors Corp., Bristol, Conn.

Replacement pulleys available through United Motors System and its Authorized Bearing Distributors.

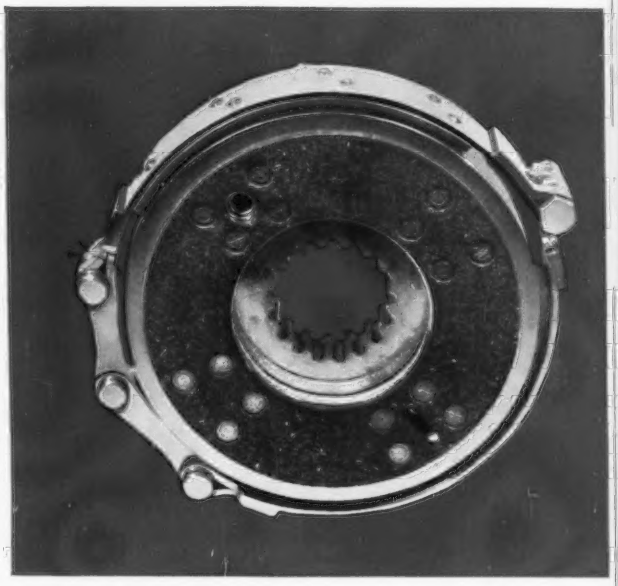
NEW DEPARTURE
BALL BEARINGS
proved reliability you can build around

BENDIX ANNOUNCES FIRST BAND/DISC TRACTOR BRAKE



Bigger brake capacity in smaller package

Now—from Bendix, brake headquarters of the world—comes the *first* band/disc tractor brake—a *better* brake for tractor manufacturers, dealers and operators alike. This unique design provides increased torque capacity in a smaller brake—and permits rapid heat dissipation for added efficiency. It is entirely enclosed on the tractor for safety, and is sealed against the dust, mud and water of farm work. It has a minimum number of parts for easiest maintenance. Adjustments are simple and external.



- **NEW, SIMPLE DESIGN.** Band/disc combination provides high, self-energizing torque output; maximum lining area in minimum space.
- **INSTALLATION.** On wheel or jack shaft.

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Near the Top

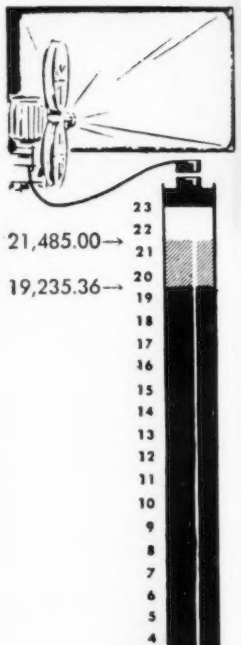
THE big story during the month of July, concerning the ASAE career motion picture, is the excellent response in the form of contributions from industry. These contributions bring the total to date from industry to $7,500.00. As shown in the "progressometer" commitments are only $1,515.00 short of the established goal of $23,000.00.

Although finances have not been completed, the film has been released and made available at USDA film lending libraries throughout the United States (see page 523). From all indications ASAE members, local sections and college agricultural engineering departments are really taking over the job of publicizing, promoting and showing the new film. An account of some of these activities appears on page 501.

Even more than was expected also is the non-ASAE support in promoting the film's use. A report from USDA indicates that 15 requests for the film have already been received for TV showings, which, it is estimated, averages 50,000 viewers per showing. Also, during the month of July 2800 people viewed the film when it was shown 478 times in the Patio Theatre in Washington, D. C. T. John Reed, president of American Planter Co., and district governor of District 636 of Rotary International, gave special mention to the availability of the film in his monthly governor's letter which is received by 47 Rotary clubs.

The following excerpts are taken from letters received from organizations which have extensive career programs for youth:

"We would certainly appreciate receiving 150 copies of the brochure which describes your 14-minute motion picture. In my opinion this would be of considerable interest to the many American Legion Posts and Auxiliary Units throughout the country as a fill-in for their meetings and at the same time portray to their membership the opportunities available to students in agricultural engineering. We also have a film distribution center here at National Headquarters and I will see that the person in charge has a copy of the brochure with the thought in mind that he could make the information available to persons who write in for career films."—Ed Wieland, Director, Education and Scholarship Program, The American Legion.



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"We are quite anxious to disseminate information regarding the color movie, 'Agricultural Engineering — A Career with a Future,' which you now have available. We have agreed to publicize this among the Michigan chapters with an invitation to send one of the agricultural engineering faculty people out with it to various clubs who would like to have a program built around it.

"Also, I would like to have a set of the literature which you indicated in the Five-Step Program concerning the use of the film. Thus, I will be able to know the steps that your various chapters are using in making the best use of this film in their areas." — Richard T. Fallon, Executive Director, Junior Engineering Technical Society, Inc.

★

". . . An excellent film. We do not list films in our Career Index — as a rule. In this case, based on the information in your flyer we would like to list it." — (Mrs.) Edythe Uhlemann, Research Assistant, Chronicle Guidance Publications, Inc.*

**Editor's Note:* A similar listing of an ASAE career brochure brought around 10,000 requests.

Savings Pile Up With Torrington Needle Bearings

You get performance-plus at a low, low unit cost when you specify Torrington Needle Bearings. A full complement of small-diameter rollers provides a maximum number of contact lines. The result—a higher radial load capacity at a lower unit cost than any other bearing of comparable size or performance.

Precision rollers operate smoothly and efficiently, with a low coefficient of starting and running friction. Positive roller retention is insured by turned-in lips on the outer shell, permitting faster and easier installation or assembly.

Your Torrington representative is an expert on Needle Bearings. For full information on how they can bring savings and improved product design and performance call Torrington—maker of every basic type of anti-friction bearing.

TORRINGTON NEEDLE BEARINGS FEATURE:

- Full complement of retained rollers
- Unequalled radial load capacity
- Low coefficient of starting and running friction
- Low unit cost
- Long service life
- Compactness and light weight
- Runs directly on hardened shafts
- Permits use of larger and stiffer shafts

progress through precision **TORRINGTON BEARINGS**

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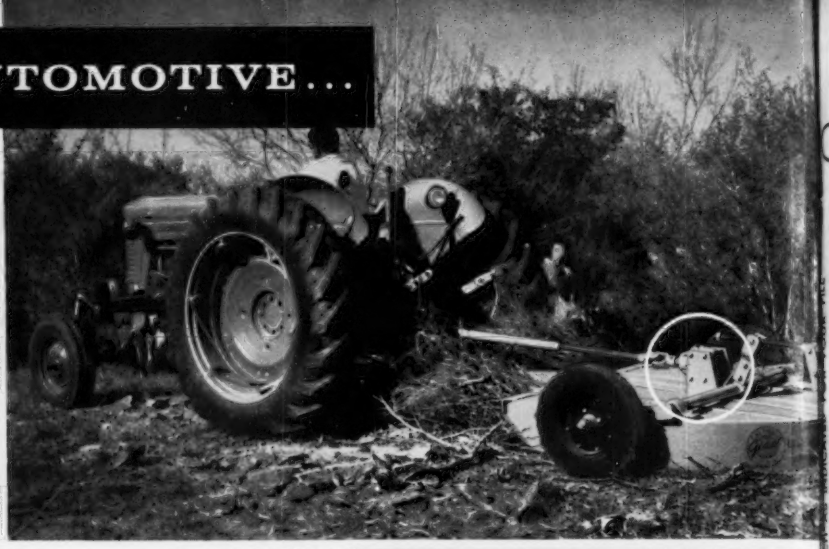
WA
47
RATIOS: 1.593-1 and 1.47-1
RATING: 40 H.P.
GEARS: Automotive type, 25-15 straight cut bevel teeth, teeth 5 pitch, 20° P.A.
INPUT: 540 R.P.M., 4712# inches torque. Available splined, keyed or plain or also available with torque limiter.
OUTPUT: 1063 R.P.M. at stated P.T.O. speed. Available splined, keyed or plain, and with or without nubs.
HOUSING: Malleable iron.
MOUNTING: Any of three sides, all holes drilled and tapped.



WA
57
RATIO: 1.21-1
RATING: 75 H.P.
GEARS: 17-15 straight conilex bevel cut teeth, 3¼ pitch—20° P.A.
INPUT: 540 R.P.M., 8753# inches torque. Available splined, keyed or plain.
OUTPUT: 653 R.P.M. at stated P.T.O. speed. Available splined, keyed or plain.
HOUSING: Two piece, input side sturdy cast iron, output side Malleable iron.
MOUNTING: Malleable iron mounting ring.

Warner muscle makes mincemeat of mesquite

ROTARY CUTTER CLEARS OVER 5 ACRES PER HOUR—THANKS TO RUGGED NEW GEAR BOXES THAT ABSORB HEAVY SHOCK LOADS—AND TRANSMIT MAXIMUM POWER

To increase performance and so cut costs for owners, E. L. Caldwell & Sons specify 40 H.P. gear boxes—engineered and manufactured by Warner Automotive—America's largest supplier for rotary cutters.

Warner experience in design and production of tough, trouble-free power transmissions increases equipment life, adds to reliability and *salability*.

The WA 47 series speed increaser gear box—with input and output shafts and gears of integrally forged 8620 carburized and hardened alloy steel—owes its superior durability and efficiency also to anti-friction bearings individually calculated for specific loads.

CAPABILITY	SPEED	MATERIAL
1 1/16 A/Hr.	2½ MPH	Up to 2"
3⅜ A/Hr.	5 MPH	Up to 2"
5⅜ A/Hr.	8 MPH	Up to 2"

For the Lilliston rotary cutter, the manufacturer specifies the 75 H.P., 57 series gear box—a heavy-duty performer which proves the advantages of Warner Automotive's precision manufacture and quality control.

Rugged gears and shafts of 8620 alloy steel—carefully splined together—put maximum power at the payoff point of production.

Put Warner Automotive know-how and production efficiency to work for you.

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BEARING BRIEFINGS

One in a series of technical reports by Bower

ROLLER GUIDANCE— VITAL FACTOR IN BEARING LIFE

Roller guidance has been established by the Anti-Friction Bearing Manufacturers Association as a major rating factor for roller bearings. There is a direct relationship between this factor and the life and capacity of a cylindrical roller bearing under load.

Figure 1 illustrates the results of a loose fit between a roller and the guiding ribs of the raceway. Because of lack of guidance by the ribs, the roller is free to skew and skid under load. Such a condition invariably leads to early bearing failure.

To achieve close roller fit and proper roller guidance, Bower precision grinds each bearing race on specially designed centerless grinders. In this operation, Bower positions the integral raceway ribs *from the theoretical centerline of the bearing*. This method produces bearings with high dimensional accuracy and perfect symmetry.

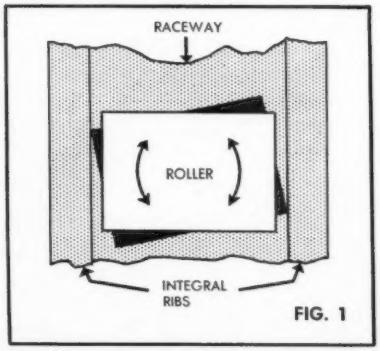
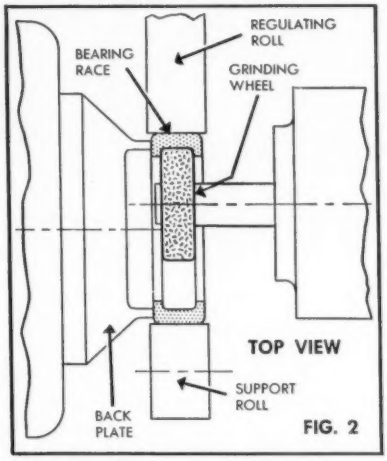
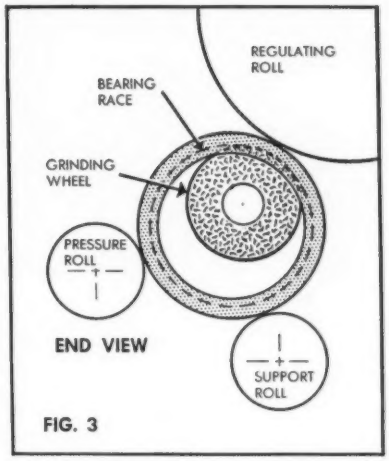


Fig. 1. Loose fit in raceway means poor roller guidance. Roller can skew and skid under load.

In addition, the close tolerances held in grinding the roller track and integral guiding ribs give Bower cylindrical roller bearings the ability to *take thrust in any direction*. A Bower cylindrical roller bearing has thrust capacity of from 10-15% of its rated radial capacity!



Figures 2 and 3 diagram the centerless grinding method used to finish Bower raceways. Use of this technique assures not only optimum roller guidance and maximum bearing life, but also virtually eliminates bearing runout. BEARING SYMMETRY WHICH RESULTS FROM THIS TECHNIQUE PERMITS ACCURATE SHAFT LOCATION REGARDLESS OF HOW THE OUTER RACE AND ROLLER ASSEMBLY ARE INSTALLED. IT COMPLETELY ELIMINATES THE POSSIBILITY OF IMPROPER INSTALLATION.



★ ★ ★ ★

Whatever your bearing needs, we suggest you consider the advantages of Bower bearings. Where product design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in a full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION — FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

Report to Readers . . .

ENGINEERS TEST CATHODE RAYS FOR STERILE MILK PRODUCTION

Michigan SU agricultural engineers have set their sights to find out how to package sterile milk so it can be kept at room temperatures for two or three months without souring. Research studies have already discovered ways for destroying all bacteria that spoil milk, and the problem now is to get the sterile milk into some kind of package for storing while keeping it sterile. . . . . Not only would processors need to sterilize containers, but they would also have to sterilize filling machinery and keep everything sterile during the entire processing operation. Most known methods for sterilizing coated-paper containers with heat are not suitable. The engineers are, therefore, presently making laboratory tests with cathode rays which kill the bacteria present without harming the containers and permit sterile milk to be packaged. . . . . One major obstacle to be surmounted in such a development seems to be the tremendously costly change-over with which processors would be involved to meet the new requirements. However, agricultural researchers will continue to work closely with industry until the desired goal is reached.

ENGINEER DEVELOPS THREE-WAY PINCH VALVE FOR AUTOMATIC FEEDING SYSTEM

One of the keys to the success of an automatic poultry-feeding system developed by a USDA agricultural engineer is said to be a three-way pinch valve located at several intervals along the pipeline, through which the freshly ground feed is conveyed to the several separate automatic feeders. Especially built for the system by this engineer, each valve is equipped with two branch-pipe outlets, each of which can be opened or closed automatically to route feed to different locations. The valve consists of a metal tube with collapsible rubber liner. The tube and liner operate like the teat cup and liner of a milking machine. When compressed air is injected between the tube and liner, the liner is forced to collapse and divert the feed to the other outlet.

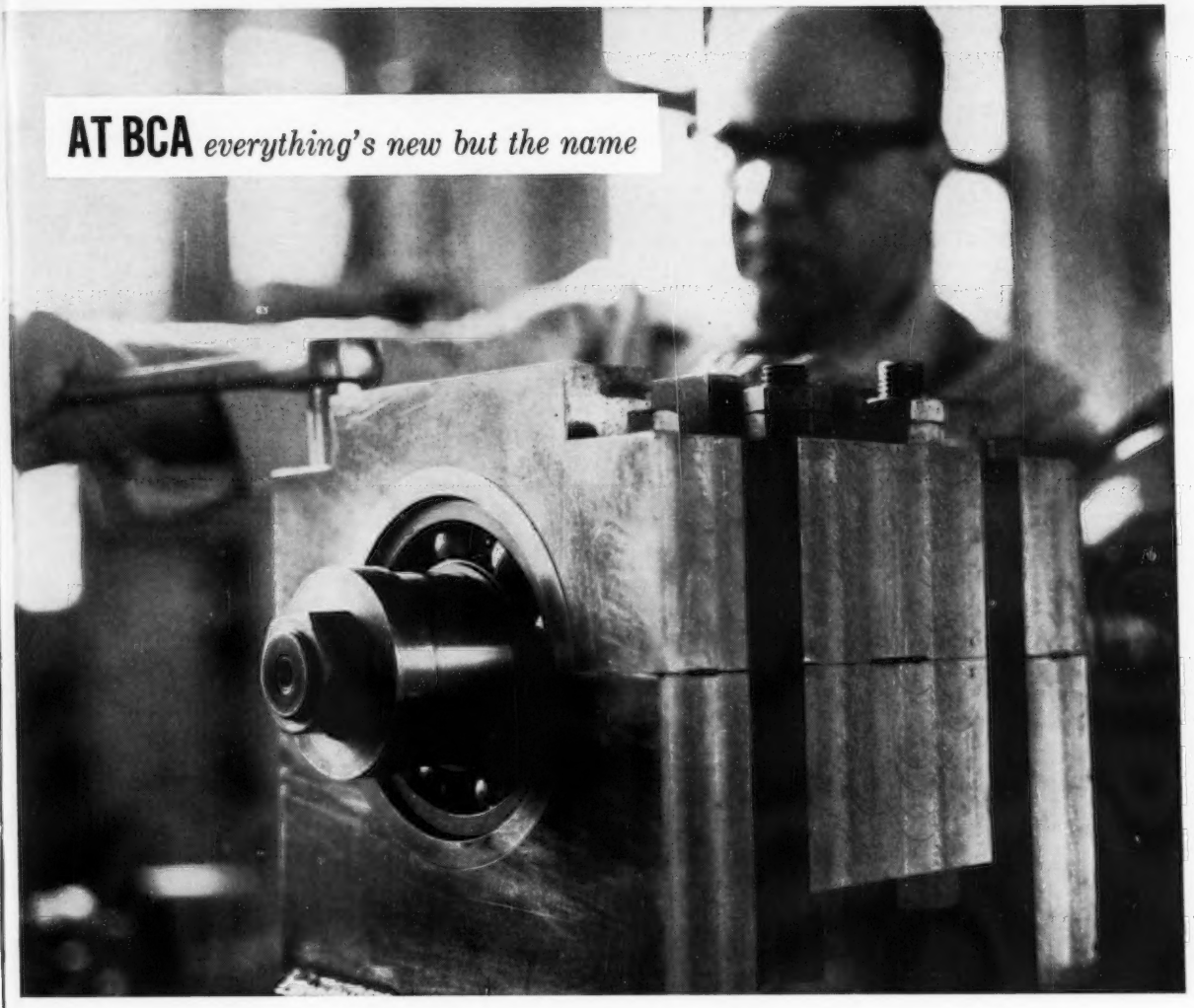
DRY-HYDRANT METHOD OF DRAFTING WATER FOR FIGHTING FARM FIRES

One of the more useful ways in which agricultural engineers, particularly those in state agricultural agencies, can serve farmers is in developing and promoting facilities for combatting the costly menace of farm fires. One of these means, that Cornell agricultural engineers are recommending to the farmers of New York state, is use of the dry-hydrant method of drafting water from ponds and streams for fighting farm fires. These installations enable farm and all rural residents to avoid such difficulties as ponds too far from buildings and water sources inaccessible for making draft connections or covered with ice. . . . . Ponds, streams, or cisterns may be used as a water source for the dry hydrant. Also, the hydrant is practically foolproof, requires almost no maintenance, and can be tested with a pumper the same as a standard pressure hydrant.

EXPANDING USE OF VERTICAL SILOS FOR STORING HIGH-MOISTURE CORN

An Iowa SU extension agricultural engineer told a group of silo manufacturers and distributors recently that the use of vertical silos for storing high-moisture corn had mushroomed in that state in the past five years. Silos erected in Iowa in 1955 for high-moisture corn storage had a total capacity of 275,000 bushels, but four years later, in 1959, silo manufacturers reported erecting silos in the state that year for high-moisture corn that provided an additional storage capacity of 2,490,000 bushels. . . . . This development has contributed to making the silo a more flexible structure, since in addition to its use for high-moisture shelled corn and any type of silage, it can be used for storing dry shelled corn and possibly for hay wafers or pellets.

(Continued on page 488)



NEW "TORTURE CHAMBER" FOR RADIAL BEARINGS

duplicates military acceptance tests

This is a torture chamber for radial bearings. Here BCA ball bearings are run . . . hour after hour . . . under loads of 5000 pounds per bearing – matching military acceptance tests for radial bearings. This special BCA-built device is an important control and development tool. It provides essential data for BCA's ball bearing research program.

This tough performance test is an example of the greatly expanded research and testing facilities which BCA has developed for the benefit of bearings users. Reason: to provide the finest possible ball bearings to customers. Results: bearings which consistently exceed performance specifications on whatever kind of jobs they are designed for.

Among the extensive new facilities at the BCA laboratories is a Temperature-Humidity-Controlled Instrumentation Room containing precision instruments, many of which have been specially designed and modified for bearing research. There are a number of unusual testing devices, too; in design, identical to equipment in customers' plants. On these, BCA bearings can be tested *under the exact operating conditions specified by the customer.*

BCA provides a complete line of ball bearing sizes and types for nearly every kind of industry. They're standard original equipment on automotive, machine tool, earth moving, and agricultural equipment, for example. And, you'll find BCA a dependable source not only for high-performance ball bearings but engineering assistance, should you need it. For more information, contact Bearings Company of America, Division of Federal-Mogul-Bower Bearings, Inc., Lancaster, Pa.

BCA

BEARINGS COMPANY OF AMERICA

ball bearings

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC.

. . . Report to Readers (Continued from page 486)

ENGINEERS DEVELOP INEXPENSIVE NEW FARM-BUILDING ROOF TRUSS

USDA agricultural engineers announce that they have developed a new farm-building roof truss that is inexpensive, that has balanced design, and that is lightweight, strong, easily fabricated, and economical. Economy is made possible by the balanced design and wood construction. To build this truss, 24 feet long, only about 70 board feet of two-by-fours and 1½ pounds of 16d nails are required. It is said this truss will safely support 125 pounds per lineal foot over a span of 24 feet. . . . . Since no precision cuts are necessary, the engineers say it should be possible to construct one of these trusses in less than an hour. The top of the truss is wide enough to be walked on while the roofing purlins are being applied.

POSSIBLE IMPROVEMENT FOR MOLE-TYPE LAND DRAINAGE

In the light of sketchy information thus far available, it appears that a Finnish engineer may have hit upon a significant improvement for making the underground, mole-type drainage channel more durable. . . . . After the channel is formed by the mole plow, the earth wall surrounding it is heavily impregnated with plastic, resin, glue, etc., in either liquid or powdered form. Such a binding means mixed with the soil forms a reasonably strong drainage conduit, according to this engineer, which he says is low in cost and long wearing and which does not clog.

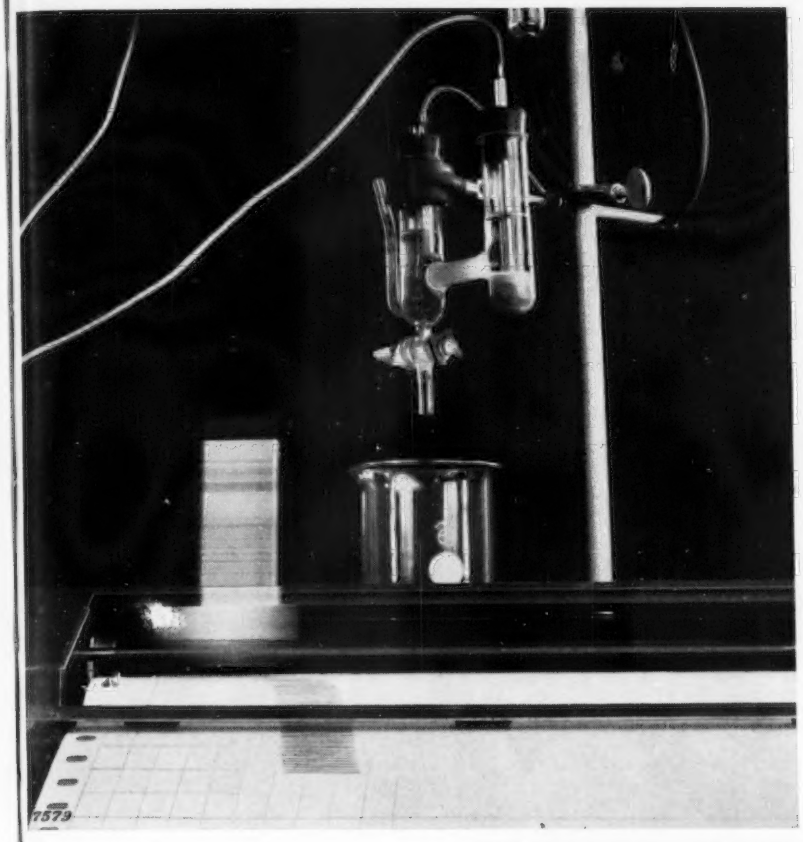
AUTOMATIC POULTRY-FEEDING SYSTEM PROVIDES ROUND-THE-CLOCK SERVICE

A USDA agricultural engineer cooperating with Illinois AES researchers has developed a system for complete automatic handling of feed for poultry, from bulk-storage bins to feeders. Both experimental devices and commercial equipment are used to blend, grind, convey, and distribute feed automatically. . . . . Eight bulk-storage bins hold the ingredients for four basic rations. The bins are automatically unloaded by augers into meters of the hammermill. After grinding and mixing, the feed is discharged into an airlock - similar in principle to a revolving door - that places it in the pneumatic conveyor. . . . . Then the feed is blown through a one-inch pipe to small storage bins at discharge stations in the poultry houses, from where it is distributed at set time intervals by automatic feeders, which maintain a constant supply of freshly ground feed for each group of birds. . . . . This entire system can be controlled by a bin switch at each feeding location, or by manually setting an interval timer at the control panel near the hammermill. It is possible to control the type of mix to be delivered to each location simply by setting dials placed on the hammermill.

SHOVELS-TO-PUSH-BUTTONS SPARKS FARM MATERIALS-HANDLING TREND

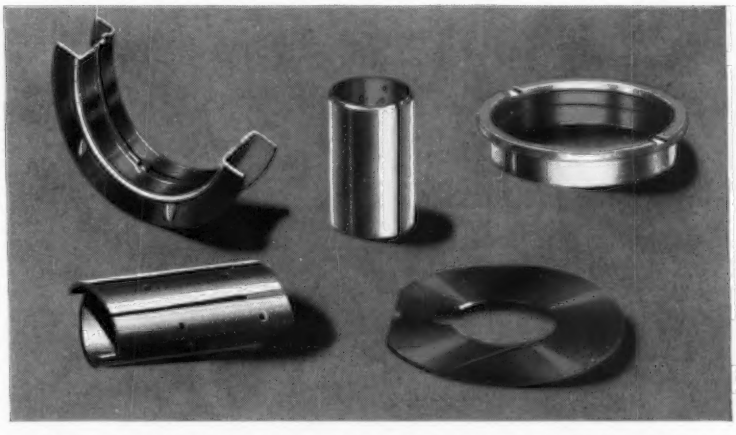
The coming decade may well demonstrate the fact that mechanization of farm materials handling constitutes a development second to none in importance in the whole gamut of progress toward mechanized agriculture. The nineteen twenties saw the real beginnings of the mechanization that was destined to lift the farm work load from the backs of animals, and the nineteen sixties may well see even greater strides in the development of mechanical power and equipment to lift the farm work load from the backs of humans. Indeed the proverbial farm boy, who said the reason he left the farm was because everything he picked up was heavy, is likely to be impressed again and again with the fact that his argument is no longer as valid as in dad's or granddad's day. . . . . In recent years the rapid progress in mechanizing farm materials handling has been reflected in the more prominent place given to the subject on meeting programs of the American Society of Agricultural Engineers. A significant facet of this development is the ASAE-sponsored farmstead engineering conference featuring the subject: "Confinement Housing of Livestock," to be held at Urbana, Ill., next month. It hardly need be stressed that the subject is another straw in the wind of increasing challenges that confront agricultural engineers in the nineteen sixties.

ANALYTIC "BLOODHOUND" SNIFFS OUT SECRETS OF BEARING CORROSION



WE USE THIS HYPERSENSITIVE DEVICE TO TRACK DOWN ENGINE BEARING CORROSION TO ITS SOURCE. This instrument needs only a minute fragment of metal for accurate analysis. Consequently, engine bearing corrosion can be traced from its beginning through complete destruction of the bearing surface. Because test variables are minimized, Federal-Mogul engineers can accurately relate degree of corrosion to specific engine operating conditions. This analytical tool is in continual use in our laboratory, assisting research on many different projects. Prevention of corrosion and development of new bearing alloys are high on the list!

SUCCESSFUL BEARING PERFORMANCE depends on selecting the proper alloy for the operating conditions to be met. Federal-Mogul engineers have had years of experience with bearings and applications of all kinds . . . and this wealth of knowledge is available to bearings users. This is one reason why F-M sleeve bearings, precision thrust washers, formed bushings, and low-cost spacers are chosen for use in virtually everything from baby buggies to heavy industrial cranes.



There's much valuable data in our Design Guides on sleeve bearings, thrust washers and bushings; and in our brochure on spacers. For your copies, write Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc., 11081 Shoemaker, Detroit 13, Michigan.

FEDERAL-MOGUL

sleeve bearings
bushings-spacers
thrust washers

DIVISION OF
FEDERAL-MOGUL-BOWER
BEARINGS, INC.

New Springday V-Belt plant at Springfield, Mo., manufacturing arm of Dayton Industrial Products Co., was designed and built for the single purpose of producing better V-Belts, in quantity.

Here's why Dayton alone can build production V-Belts, in any quantity, with individual custom-built quality

New Springday plant sets higher standards of quality for Dayton V-Belts

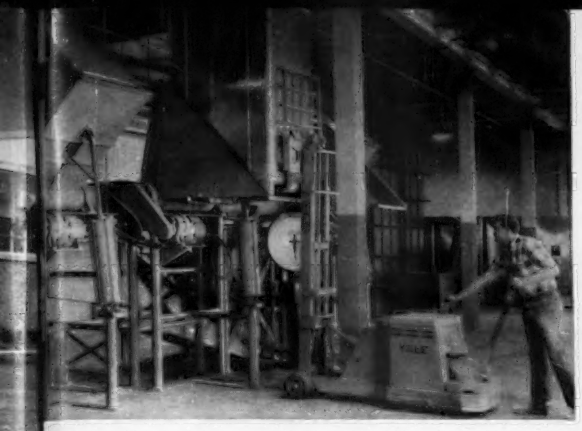
Here's real news for you, whether you buy V-Belts for O.E.M. or replacement applications. Dayton's new, completely automated Springday plant eliminates the need for spot-checking production belts, saves you time and money. This is possible because each Dayton V-Belt comes off the line in custom-designed quality at this new plant—the only one of its kind—built specifically and solely for the design and manufacture of V-Belts.

Designed from the "inside-out" by our own Central Engineering staff, this plant incorporates every known, reliable facility for effecting optimum product quality control, efficiency of production and delivery. Where existing machines would not meet the increased standards, new ones were designed, patented and built to do the job.

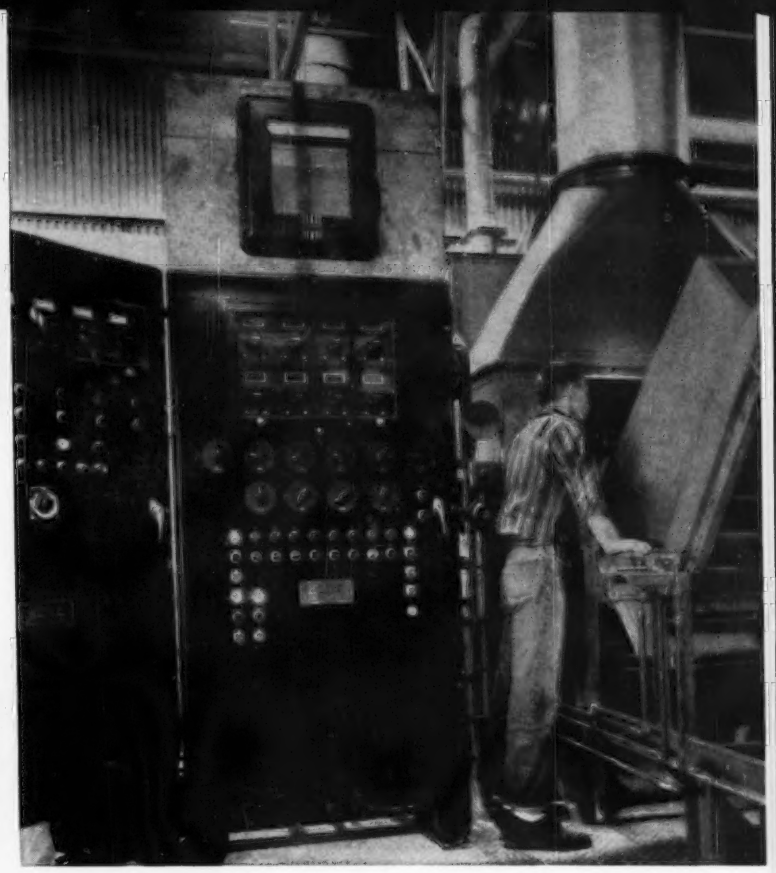
Recently awarded the distinction of being named by Factory Magazine as one of the Top Ten plants built in 1960, it has been referred to as "a masterpiece of plant layout and material handling . . . quickly became world's largest producer of V-Belts . . . a truly significant plant."

We, too, feel it is a significant plant; principally, however, because it can and is mass producing Dayton Industrial V-Belts to an individual excellence of quality that would not be possible to achieve by a multi-product plant. Here are a few of the reasons why—

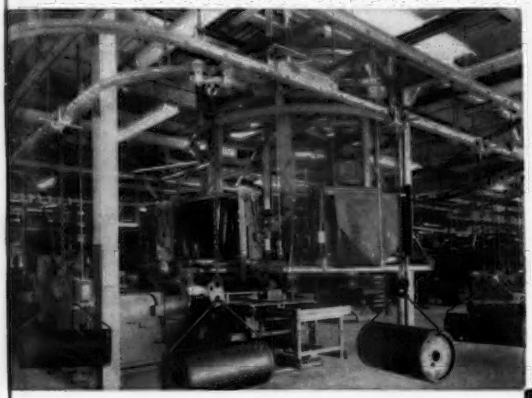
Foolproof mixing. Dayton's new monorail unit moves along overhead track as operator weighs out dry ingredients and oils, used to condition rubber stocks, according to exact formula required.



▲ **Dustless Handling of Carbon Black** is masterpiece of materials handling. Containers are placed in position by fork lift truck; automatically open to add carbon black via auger-type feed, correct amount is measured electronically.

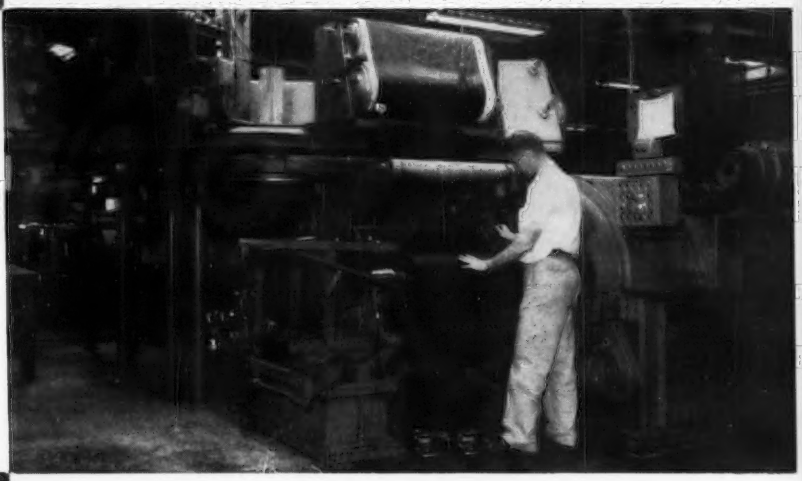


▲ **Automatic loading of new stock** into Banbury Mixer speeds mixing, assures continous flow of stock to collanders. Collanders roll stock to precision thickness for belt making.

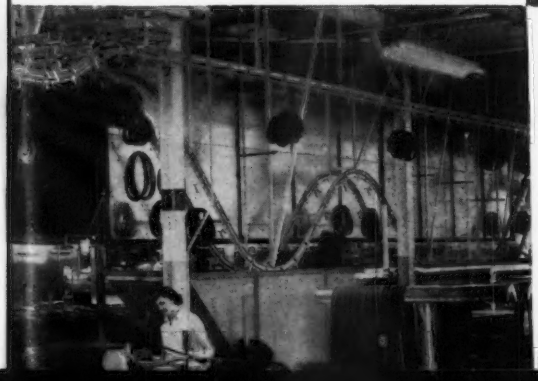


▲ **New Multi-station Belt making machine** applies rubber stock in correct ply layers. Belt-making drums are delivered to and removed from machine by continuous overhead conveyor.

▶ **Many patented and exclusive innovations and improvements in** belt building assure optimum production and quality control. This rotating Carousel provides operator with 6 different types of ply stock at the touch of a pedal.



Final check "sag" test. Each belt receives Dayton's special "sag" test to insure proper belt matching. In background, uncured belts are carried by conveyors ▼ to curing room.



Dayco

INDUSTRIAL DEPARTMENT

Dayton Industrial Products Co.

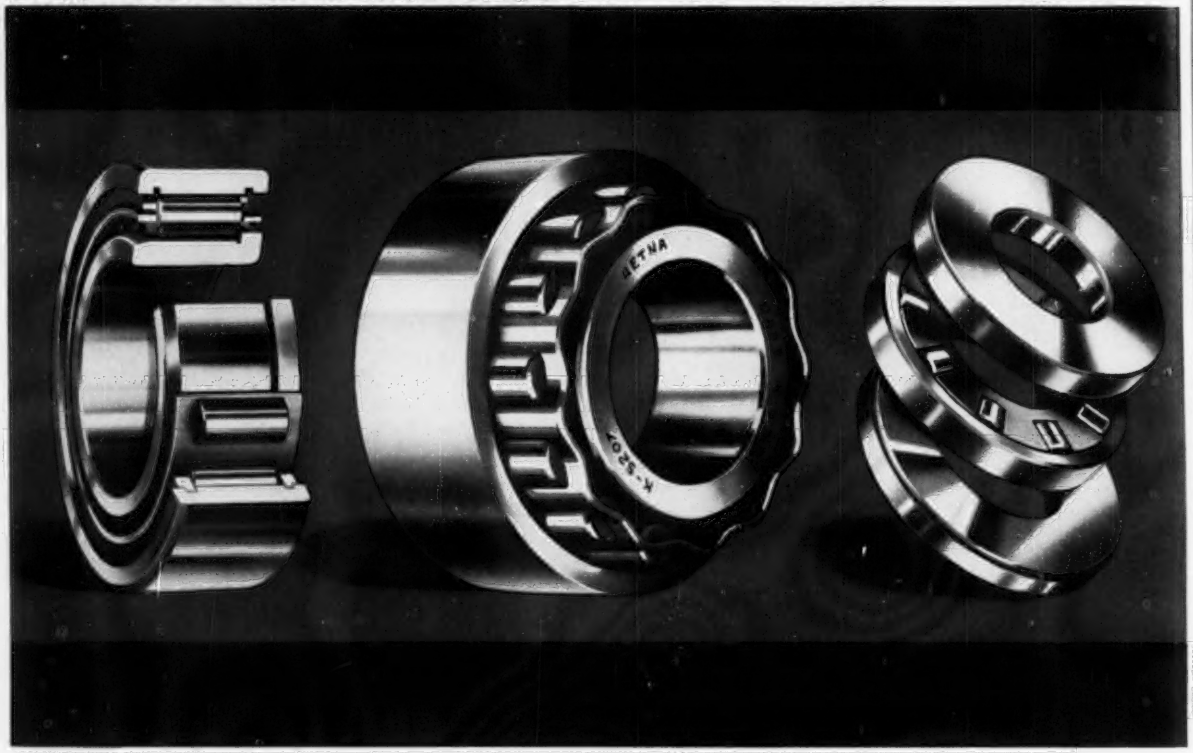
A Division of Dayco Corporation (formerly Dayton Rubber)

2001 Janice Ave., Melrose Park, Ill.

Telephone: ESterbrook 9-5700 regarding specific questions, or see the Yellow Pages for your nearest Dayton Distributor.

Aetna
ROLLER BEARINGS

What would you pay for greater bearing efficiency?

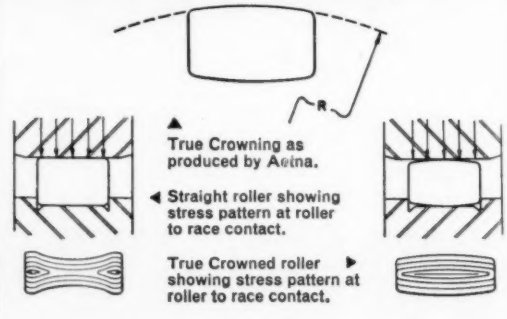


Under extreme load conditions, Aetna True Crowned Roller Bearings have proved their greater efficiency. In exhaustive comparison tests between straight rollers and crowned rollers, utilizing the AFBMA formula, the Aetna rollers recorded an increased load capacity of over 25% and a longer life expectancy of more than 120%.

What does this greater operating efficiency cost you? Absolutely nothing . . . Aetna True Crowned Roller Bearings are not premium priced!

So . . . when you need roller bearings, consider the greater efficiency of Aetna True Crowned Roller Bearings at no extra cost. They are available in a wide range of self-contained, pure radial standard designs, and can be made to order in many special designs of both pure radial and pure thrust for unusual applications.

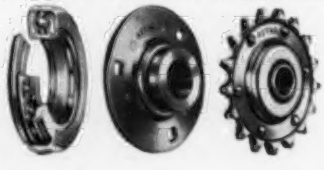
For complete information on Aetna True Crowned Roller Bearings, call your Aetna representative listed in your classified telephone directory, or write for General Catalog and Engineering Manual.



▲ True Crowning as produced by Aetna.

◀ Straight roller showing stress pattern at roller to race contact.

True Crowned roller ▶ showing stress pattern at roller to race contact.

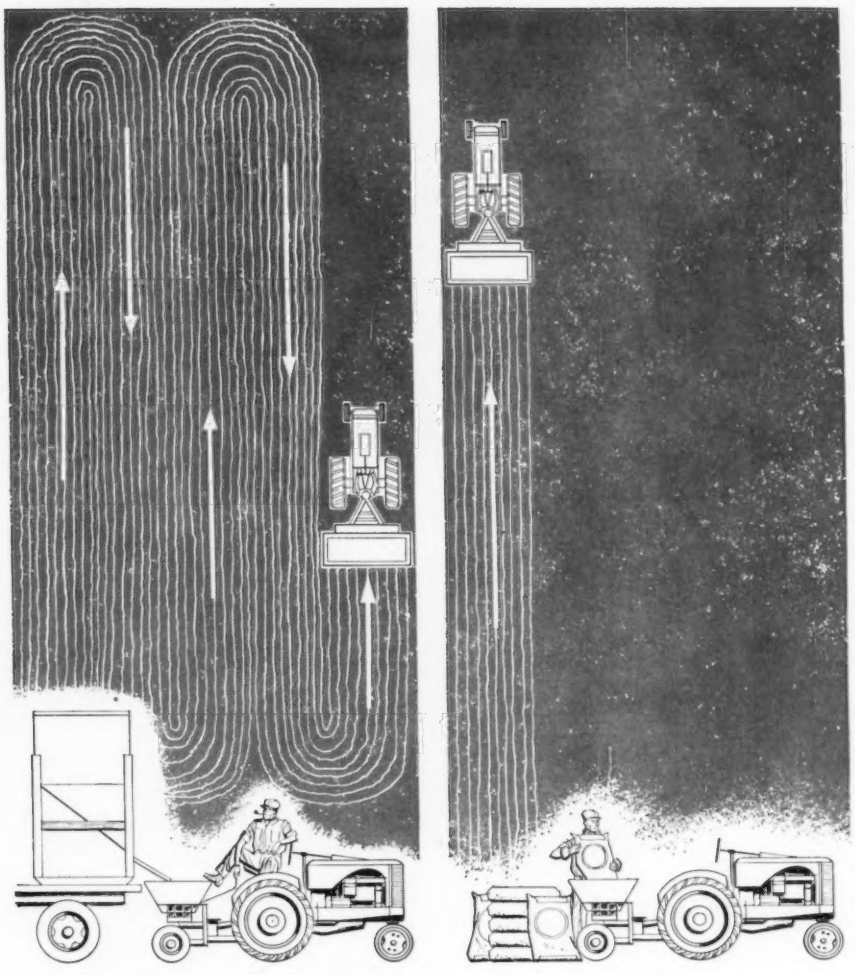


AETNA BALL and ROLLER BEARING COMPANY
DIVISION OF PARKERSBURG-AETNA CORPORATION

4600 SCHUBERT AVE.
CHICAGO 39, ILL.

ANTI-FRICTION SUPPLIERS TO LEADING ORIGINAL EQUIPMENT MANUFACTURERS SINCE 1916

bulk handling



how to spread more fertilizer faster

See how much more fertilizer you can spread in a shorter time if you handle it in bulk. With proper equipment, bulk handling is a quicker, more efficient method for both farmer and dealer. It eliminates lifting, tearing and emptying heavy, clumsy bags.

It's now possible to move fertilizer in multi-sized packages from dealer to farmer without manual handling, thanks to steel-built handling equipment. This special equipment was developed to reduce costly labor and handling, and is being used in more and more farm areas. For further information on this time- and money-saving way to handle fertilizer, write U. S. Steel, Agricultural Extension, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS is a registered trademark

This mark tells you a product is made of modern, dependable Steel.

United States Steel

Try step-ahead power that's fully farm proved

30,000,000 owner hours have fully proved pace-setting advantages of new FARMALL® and INTERNATIONAL® tractors. Now, your IH dealer invites you to try these big differences . . .

You don't know what you've been missing in modern farm power until you try *big IH differences* in a new Farmall or International tractor! And remember, these money-making, muscle-saving, day-stretching differences are *fully* farm proved by over *30 million hours* of field work!

You can bet that the engines . . . transmissions . . . hydraulic systems . . . and other step-ahead advantages of new IH tractors will be copied. But only on new Farmall and Internationals are these unequaled advantages *completely* field proved.

Your IH dealer urges you to compare new IH tractors with *all* others—in *all* ways! Compare power and all-job economy. Compare work-saving features and basic construction. When you finish your feature-by-feature comparison and a field test, you'll know dozens of reasons why a new Farmall or International is your best buy.

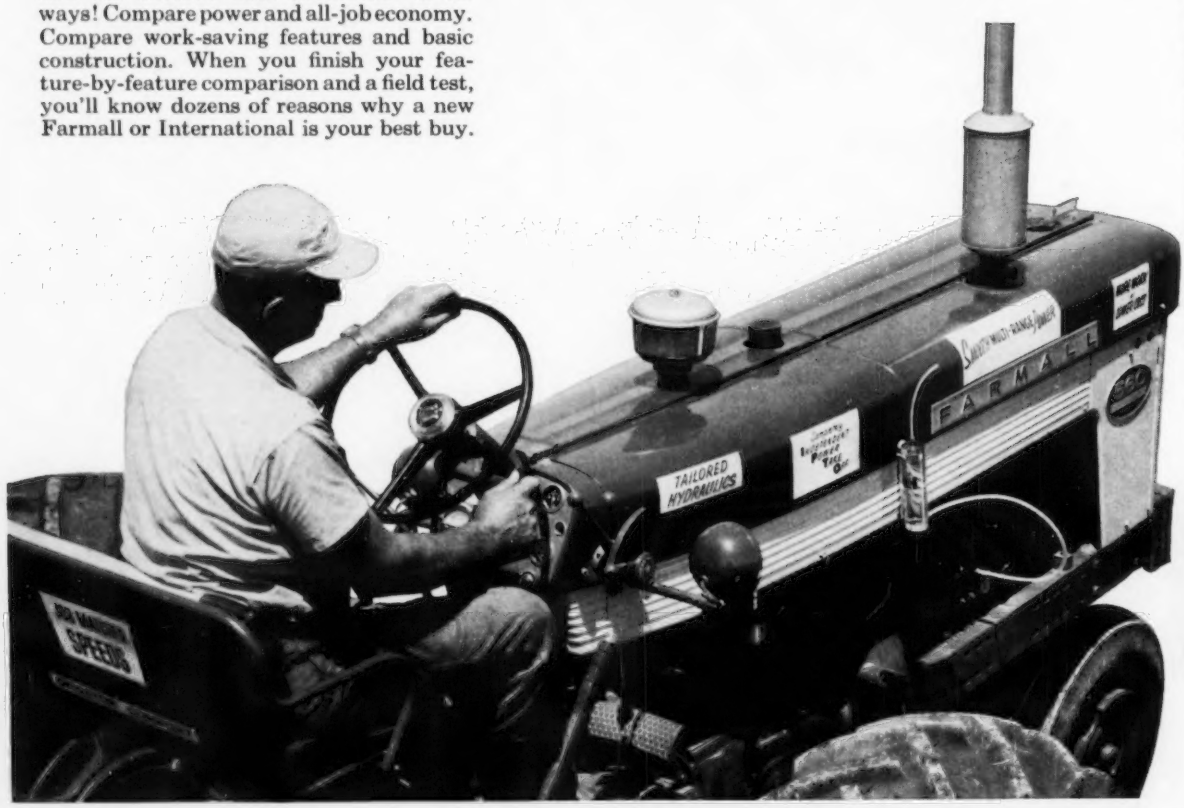
Try trouble-free Torque Amplifier! See how this farm-proved transmission assist boosts pull power up to 45% on the go . . . helps you match power and speed to every job and load. What's more, TA is *extra* tough for full-time, unrestricted use.

Measure economy of IH Multi-Range power on a light job. Shift up . . . "throttle back" for just-right speed. Big Farmall 460 and 560 tractors "loaf" on light loads to rival economy of small tractors, yet deliver plenty of big power when needed.

Control Fast-Hitch equipment easier, more accurately with new Micro-Set Tel-A-Depth. And remember, only Fast-Hitch gives you seconds-quick, *from-the-seat* implement hitching, plus Traction-Control that *constantly* matches traction to the load.

Call your IH dealer today! Pick the new, millions-of-hours-proved Farmall or International tractor you'd like to try. He'll have this tractor at your farm whenever you say.

INTERNATIONAL HARVESTER



QUALITY . . . The assurance that the second or two hundred and second SEALMASTER Ball Bearing Unit you buy will be as precision-perfect as the first. A combination of exclusive engineering features and scientifically-controlled production have made the name SEALMASTER synonymous with quality throughout industry.

PERFORMANCE . . . more hours of efficient power transmission and precision service from every SEALMASTER Ball Bearing Unit.

ECONOMY . . . more for your bearing purchasing dollar. SEALMASTER quality and performance continues to pay dividends long after the original purchase.

AVAILABLE IN A COMPLETE QUALITY ENGINEERED LINE

SEALMASTER® BALL BEARING UNITS

Normal-Standard Medium Duty PILLOW BLOCKS

Standard Medium Duty FLANGE UNITS

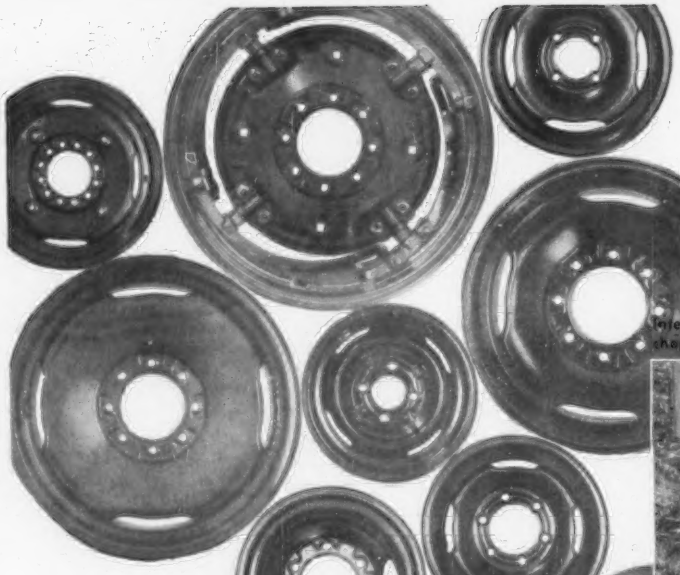
LFT FLANGE UNIT

LP PILLOW BLOCK

LF FLANGE UNIT

SEALMASTER BEARINGS A Division of STEPHENS-ADAMSON MFG. CO., 67 Ridgeway Avenue, Aurora, Illinois

PLANTS IN: CLARKSDALE, MISSISSIPPI • LOS ANGELES, CALIFORNIA • BELLEVILLE, ONTARIO • MEXICO CITY, D. F.



International Harvester corn picker-shopper and wagon.

Oliver tractor and semi-mounted plow.

Massey-Ferguson baler.

Allis-Chalmers tractor and All Crop drill.

MOTOR WHEEL

"Application Engineered" wheels meet exacting farm machinery requirements

02

Modern mechanized farm machinery demand wheels designed to exacting requirements. That's why Motor Wheel has developed a complete line of "Application Engineered" wheels . . . wheels engineered to the special needs of farm tractors and implements.

You can depend on "Application Engineered" wheels. Behind them is Motor Wheel's matchless engineering and manufacturing experience . . . experience gained by pioneering such developments as disc wheels, S.A.E. reversible wheels, and the use of power adjusted wheels.

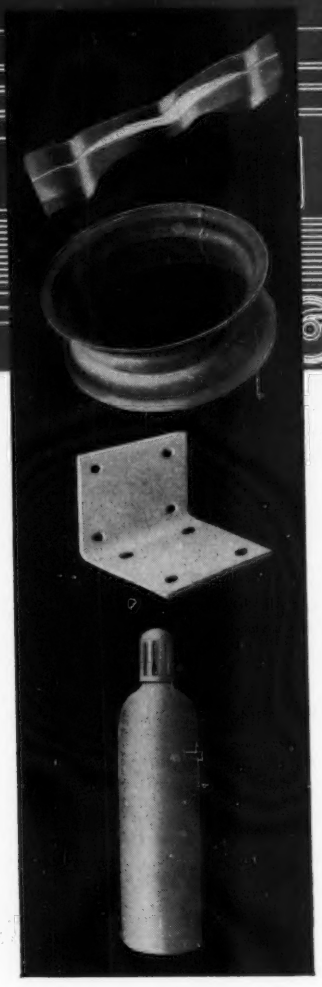
Before specifying wheels for your machinery, consult a Motor Wheel field sales engineer. He'll help you select an "Application Engineered" wheel, or arrange to have a wheel designed which will solve your unique wheel problem. Phone or write today.

Send for the new Agricultural Equipment Wheel Catalog.

Serving the Agricultural Industry Since 1903

MOTOR WHEEL CORPORATION

LANSING 3, MICHIGAN



Columbium flat-rolled steels

Do you need a steel, to use in the "as rolled" condition? Or a steel which has high strength, good weldability, good formability?

More and more manufacturers are turning to columbium flat-rolled steel products, for columbium sheet, strip or plate gives an answer to all of these requirements.

Here are just a few examples of columbium steel's wide versatility. Line pipe for gas and oil offers ease of manufacture with excellent physical strength. Trucks, automobiles, farm implements, trailers and railroad cars take advantage of strength and ease of formability. Pressure vessels utilize the deep-drawing qualities of the steel. These applications and many others tell the story of columbium steel's versatility—and all with fewer rejects.

In the face of mounting manufacturing costs, columbium steels offer hope of effecting economies in producing your products. Ask any steel company for they can make it. Or ask us—we have a wide experience in its uses and knowledge of its manufacture.

MOLYBDENUM

2 Gateway Center CORPORATION OF AMERICA **Pittsburgh 22, Pa.**

Offices: Pittsburgh, Chicago, Los Angeles, New York, San Francisco
Sales Representatives: Brumley-Donaldson Co., Los Angeles, San Francisco
Subsidiary: Cleveland-Tungsten, Inc., Cleveland
Plants: Washington, Pa., York, Pa.

In the next four hours, this farmer will do as much work as his father could do in ten hours . . . 6 extra hours for increased production or more leisure time.

The wonderful new watch that science has given farmers

Farmers today work far fewer hours than their fathers did, yet produce *more* food or feed. In the charts of the Department of Agriculture, you can see this steady climb in efficiency.

One of the reasons is *science*. With science as his partner, a farmer works near-miracles on his land.

In this scientific revolution, farm machines are an essential part. They must have the muscle to tackle today's heavier yields, substituting low-cost horsepower for expensive manpower.

New Holland machines are *science-designed* to meet these modern needs. Take the New Holland concept of *Hay-in-a-Day* . . . the One-Man Way. With a modern New Holland Hayliner and Bale-Thrower, one man can now bale faster than a two-man team.

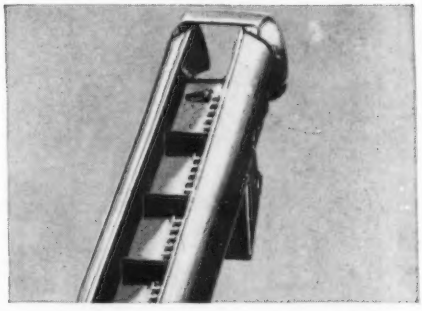
New Holland Research is in constant touch with the exciting new developments going on in the colleges and experiment stations . . . and is designing machines to match these advances.

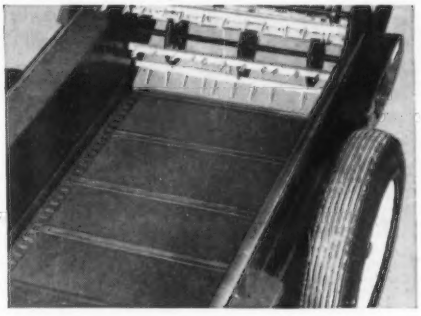
Of one thing you can be sure: New Holland will remain *first* in the mechanization of livestock farming. New Holland Machine Company Division of Sperry Rand Corporation, New Holland, Pa.

NEW HOLLAND
First in Grassland Farming

THE FLIGHT IS ON...

to save you time, trouble and money



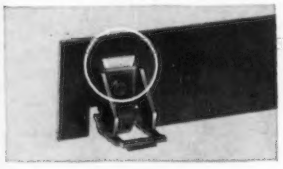


You don't have to wrestle with the tedious, time-consuming job of assembling conveyor and elevator flights on chains when you specify Rex. Neat, easy-to-handle bundles of chain with flighting on—completely assembled—are delivered right to your door. You just unroll them right onto your equipment for fast, easy installation.

You save because Rex flighting assembly is handled with greater efficiency at the factory as a natural part of chain assembly—reducing cost and eliminating trouble for you.

Types and Sizes for Every Application

Whatever type and size you need for greatest efficiency on your equipment, you'll find it in the complete Rex line of steel and rubber flighting. Flights are available on Rex Steel Detachable Chain or on a variety of Rex Roller Chains for every application. For full information, mail the coupon below.



Special Locking Device Keeps Flights Tight Longer

A special Rex locking device, permanently stamped into Rex Steel Flights, keeps a tight grip on the chain link—reinforces the rivet—eliminates twisting—keeps Rex Flights tight for maximum service life.

REX®

AGRICULTURAL IMPLEMENT CHAINS

CHAIN Belt Company
4681 W. Greenfield Ave.
Milwaukee 1, Wisconsin
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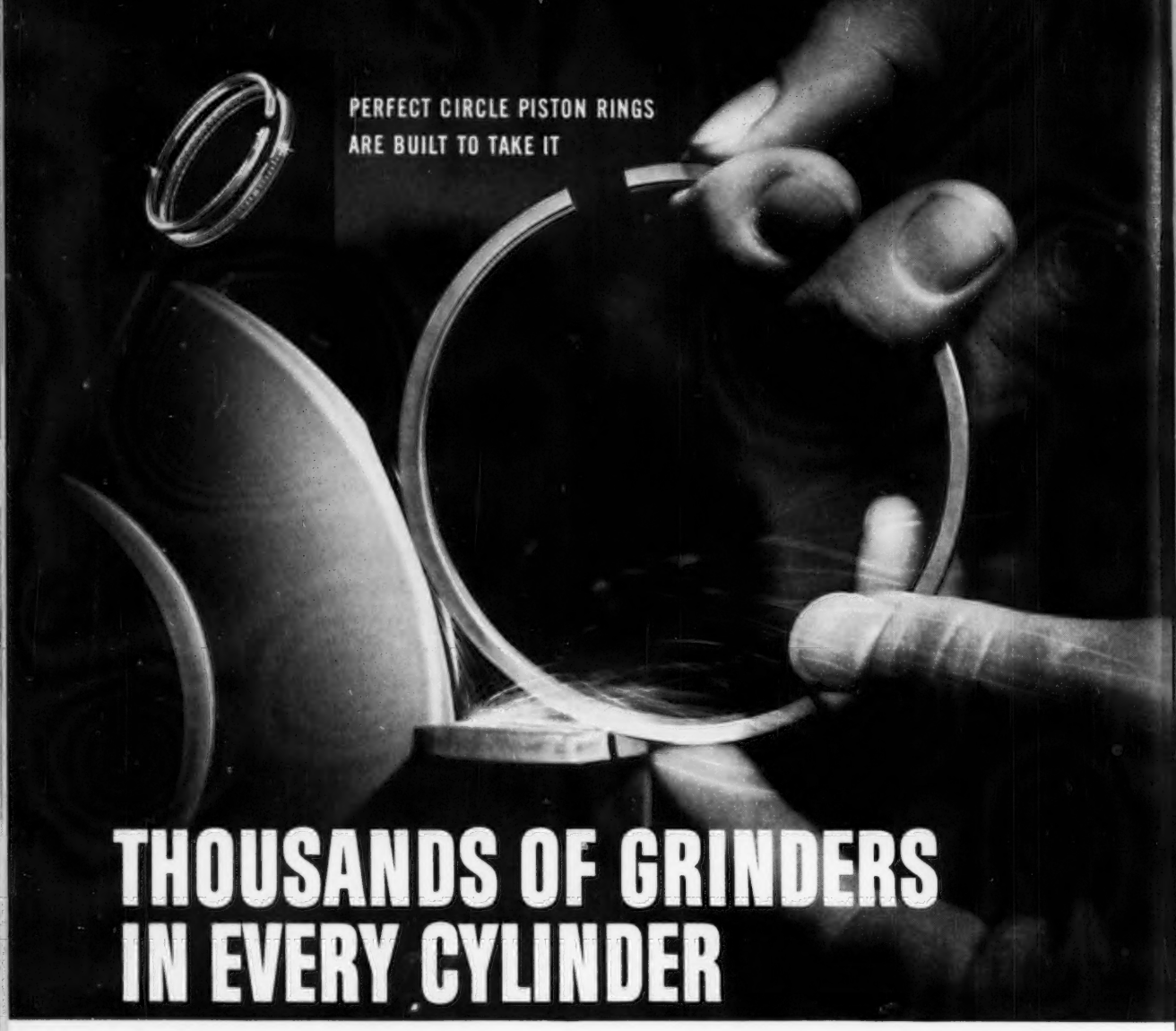
☐ Please send full information on Rex Agricultural Implement Chains with flights and slats.
☐ Have a Rex Man call.

Name.....

Company.....

Address.....

City.....*Zone*.....*State*.....



THOUSANDS OF GRINDERS IN EVERY CYLINDER

Dirt particles in a cylinder act just like tiny grinding wheels to wear away the face of a piston ring. To protect against this abrasive wear, Perfect Circle 2-in-1 rings are plated with solid chrome—the hardest, longest-wearing surface you can buy.

As a result, wear is reduced an average of 75% over non-plated rings. And, Perfect Circle's chrome plating is 25% thicker than the average of competitive plated rings to provide extra protection and extra life.

In every way, Perfect Circle rings are built to take it. Insist on Perfect Circles—first choice of leading engine manufacturers and mechanics everywhere.

PERFECT CIRCLE

PISTON RINGS · PRECISION CASTINGS · POWER SERVICE PRODUCTS · SPEEDOSTAT

HAGERSTOWN, INDIANA • DON MILLS, ONTARIO, CANADA

Agricultural Engineering

August 1960
Number 8
Volume 41

James Basselman, *Editor*

HAVE YOU SEEN THE MOVIE?

FROM all indications, if you haven't seen the new ASAE career motion picture "Agricultural Engineering — the Profession with a Future," you are in a minority among ASAE members. Since the premiere showing of the film and launching of the Five-Step Plan for promoting its use (both occurring at the ASAE Annual Meeting in June) ASAE members throughout the United States have had an opportunity to see or show the film in their own areas.

The 120 prints of the picture, which were included in the package plan for which $23,000 is being raised, have been distributed in accordance with the original plan. Twenty-seven copies have been shipped to various agricultural engineering departments, 71 copies have gone to USDA cooperating film libraries in every state of the Union (Puerto Rico and District of Columbia, included), three copies are on file at ASAE headquarters, and the remaining 19 are being used by the USDA Motion Picture Service to fill television and other requests directed to that office. These 19 copies also will be used as supplemental prints to fill needs in areas where demand is extremely high — in other words, to reinforce those areas where usage pressure is greatest.

Members are *urged*, wherever possible, to enter their requests for copies of the film through the USDA cooperating film library in their own state. (A complete list of the cooperating film libraries is shown on page 523 of this issue.) In this way, each request will be brought to the attention of the state Career Guidance Committee so that the Five-Step Plan of related promotional activities can be set in motion. Information concerning the Five-Step Plan was presented in the July issue, and complete details have been made available to the officers of each ASAE section and to the head of each college agricultural engineering department. The various film libraries have facilities for cleaning and servicing the film.

Judging from requests and comments reaching ASAE headquarters, it is believed that most states will soon have Career Guidance Committees organized to carry out an effective follow-up publicity activity associated with the scheduled motion picture showings. The objectives of this follow-up effort are to place career literature in the hands of each person viewing the picture, to obtain radio and newspaper publicity relating to the picture, to provide posters to stimulate additional interest in the film and in agricultural engineering. Many state groups are also organizing to have agricultural engineers present at each showing of the picture in order to answer questions and provide further details concerning agricultural engineering. This further points out the importance of requesting prints from the film library within the same state and in cooperating with the nearest Career Guidance Committee.

In instances where prints of the film cannot be obtained locally, or where leaflets, posters, or brochures are not available locally, they may be obtained direct from ASAE headquarters.

The following remarks taken from correspondence received by ASAE headquarters indicate the progress and interest ASAE members are showing toward promotion of the long-awaited career guidance aid:

★

"We would like to commend you on the work that you and your staff have done in laying the ground work for publicity of the film, 'Agricultural Engineering, the Profession with a Future.' The presentation of the Five-Step Plan presented at the annual meeting was excellent and is compiled in a manner that we can readily use in connection with the use of the film."

★

"Our copy of the film has been received and we have had several showings including some high school students visiting our department. The reaction is very good; and those seeing the film have complimented the film highly. Our student ASAE Club members have plans to arrange and show the film in their respective high schools. The TV program director here on campus has volunteered to help get it on some stations in this area."

★

"This film is what the profession has needed as a tool to aid in accelerating our publicity and recruiting programs, but certainly it should not be used as a crutch to replace the work and personal contact we have already been doing. We hope to make use of it as a tool."

★

"We have arranged for our copies of the movie to be placed in the University film library for use by anyone in the state. We have also arranged with our Short Course Office to make use of the movie in connection with visitation of high schools by University counselors."

★

"We just had a meeting with our state Section of ASAE and they plan to publicize the movie through their membership and to ask the membership to have the local high school counselors, etc., request the movie. We also expect the local ASAE member to offer his services to answer questions."

★

"Thank you very much for sending me a copy of the career packet prepared by your office. The material is very well prepared and I hope that it will get wide distribution. I will see what can be done in our Section in getting this material publicized."

★

"To help promote the motion picture 'Agricultural Engineering, a Profession with a Future,' we would like to have about 300 copies of the flyer that is available from your office. We have received the film, and have reviewed it, and feel that it is an excellent career film."

★

"Would you please make up a set of the 35 mm. colored slides of the charts used at the Cabinet meeting to explain the Five-Step Plan and if you have any extra career packets we would like to have either two or three sets in addition to the one which we picked up in Columbus."

★

"We are taking some steps towards getting organized to utilize the ASAE film. I have requested a supply of flyers from USDA. Now I'd like to request a supply of the leaflets and posters from your office. Could you furnish us with up to 1000 copies of the leaflet and 150 posters? I tried out the film on a group of fifty Fellowship Science teachers here this summer and had a good response from them."

★

"We are in the process of getting underway to inaugurate our recruitment campaign. Starting this week, we will have a man at the State Vo-Ag, FFA Conference. He will not have much material with him, but he will be getting teachers and others lined up for the showing of the film and receiving of literature."

★

"I was privileged to see a preview of the ASAE Career motion picture. It's a honey, and I am sure it will stimulate many youngsters to the profession."

★

"We would like to receive about 800 copies of the leaflet entitled 'Agricultural Engineering, a Profession with a Future.' This leaflet seems to be well prepared, and should be ideal for distribution at Career Days, as well as for mailing to high schools, county agents, and vocational agriculture instructors."

★

"I think that the help that your office and the USDA is giving in connection with the use of the film is very much worthwhile and is an important assist to our departments of agricultural engineering. We have shown it to a number of our folks on the campus who deal with career guidance and in each instance they have been very pleased."

★

"I would like to have you send us 500 copies of the movie promotional flyer, 500 copies of the new leaflet, 'Agricultural Engineering, a Profession with a Future,' and 300 copies of the poster, 'What Will Farming Be Like in the Year 2000?' We plan to make these posters available to each one of the 287 vocational agricultural teachers that are serviced from this college."

★

"We now have our first two copies of the new ASAE film and wish to start promoting it with our local and state-wide television stations. In order to get started with this I would like to have approximately 100 copies of the promotional flyer to send to the television stations and some of the other agencies in the state."

★

"We would like to order 1000 copies of the leaflet 'Agricultural Engineering, a Profession with a Future' and 200 of the posters 'What Will Farming Be Like in the Year 2000?' "

★

"We showed the ASAE movie during our Tractor Power and Safety Day. We darkened one corner of our power and machinery laboratory where the lunch stand was located and ran the movie almost continuously during the day. It is estimated that 500 people saw the movie through its entirety on this occasion. Several thousand people watched part of the movie as they stood in line to buy their sandwiches and refreshments. We plan to mention the ASAE Movie on 15,000 or more programs that we send out next year for this event."

★

See page 482 for response from organizations other than ASAE.

Human Energy Expended in Handling Baled Hay and Straw

Fig. 1 Platform used for bale-stacking energy tests, with elevator conveyor, adjustable-height stacking shelf and gravity slide

Fig. 2 Circular test area for carrying baled straw over a baled-straw surface. String marker is circulated at a controlled speed

Fig. 3 Circular test area for dragging baled straw over a baled-straw surface. A string on the bale is used to maintain the bale in a continuous flat position

HUMAN energy expenditures in chore labor has been a neglected subject in most studies aimed at classifying farm jobs and in comparing different work methods. Time-and-distance measurements have been the primary yardsticks in such investigations. Human energy, time, and distance are all needed to describe completely any operation. These three parameters can be used for classifying farm jobs, developing improved work methods, laying out farm buildings, and as guides in the design of machinery and equipment.

While most field work on the modern farm is highly mechanized, many of the farmstead chore jobs require considerable expenditure of human effort and time. This is especially true in the case of handling the bedding materials for livestock. Kleis (2)*, in a survey of 320 Michigan farms, determined that the time required for handling a ton of bedding was higher than for any other material normally handled on the farm. Total man-hours per ton were 2.69 for baled straw, 2.10 for chopped straw and 3.08 for loose straw. These requirements are from 2.5 to 4 times greater than for ear corn and for small grains which require 0.79 and 0.85 man-hours per ton of material handled. Both ear corn and small grains are usually handled with mechanical equipment.

Many time and distance studies have been made on most phases of farmstead chore labor; however, there are many areas of work, e.g., bedding of livestock, in which little or no energy data are available.

While many different materials are used for bedding, the primary one is baled straw in the midwest. Kleis (2) investigated 320 farms and found that 224 used baled straw, 67 used chopped straw, 10 used loose straw, and 12 used other types of materials. The objective of this study was to determine human-energy expenditures for handling baled straw. Some of the results are applicable for baled hay.

METHOD OF ENERGY MEASUREMENT

Indirect calorimetry was used in the energy determinations. This is the most feasible method in human-energy studies where the subjects are to move over relatively wide

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The authors — T. O. HODGES and M. L. ESMAY — are, respectively, professor of agricultural engineering, Kansas State University, Manhattan (formerly graduate assistant at Michigan State University), and professor of agricultural engineering, Michigan State University, East Lansing.

*Numbers in parentheses refer to the appended references.

Specific requirements in and around farm buildings

T. O. Hodges and M. L. Esmay
Member ASAE Member ASAE

areas. Muller and Franz (3), at the Max Plank Institute for work physiology, Dortmund, Germany, developed a combined portable, dry gas meter and fraction-sample collector (shown on a test subject in Fig. 5). The equipment meters all the air expired by the test subject and continuously removes a portion of the gas for later analysis.

Weir (4) has shown metabolic rate to be essentially a function of pulmonary ventilation and oxygen content of expired air. Therefore, when these two factors are determined, a good measure of metabolic rate, or energy expenditure, can be calculated. All energy determinations in this study were made by metering the expired air of the test subjects through a Muller-Franz gasometer, analyzing a portion of it for oxygen content; and then energy expenditure was calculated.

EXPERIMENTAL METHODS AND PROCEDURES

General

The baled-straw handling task in and around farm buildings is a combination of essentially four major activity components as follows: *(a)* lifting and stacking bales, *(b)* carrying bales, *(c)* dragging bales, and *(d)* shaking straw over an area to be bedded. When the energy required for each of these components is known, the total energy for the complete bedding operation for any specific physical plant can be estimated by summing the components.

Physical facilities were developed in the laboratory to study each of these activity components separately. Michigan State University men students were used as subjects in the energy determinations. The basis for selection was having had farm chore labor experience and be one of three distinct body types.

Subject 1 was 26 years old, 6 ft, 2 in. (188 cm) tall, weighed 192 lb (87.25 kg), and had a body surface area of 2.16 sq m. Subject 2 was 25 years old, 5 ft, 9 in. (175 cm) tall, weighed 172 lb (78.2 kg), and had a body surface area of 1.92 sq m. Subject 3 was 20 years old, 5 ft, 6 in (168 cm) tall, weighed 138 lb (62.7 kg), and had a body surface area of 1.70 sq m. Subjects 1 and 3 were living and working on their family farms. Subject 2 lived in university housing, but had had farm experience. All subjects were familiar with farm chore operations.

Stacking Bales

The variables encountered in lifting and stacking bales are *(a)* bale weight, *(b)* speed of handling, and *(c)* height of lifting. Two weights of bales, 45 and 65 lb, were used for this study since they are fairly typical of the two extremes of straw bale weights. Two rates of lifting and stacking, 5 and 8 bales per minute, were selected for the study. Five bales is a rate which can be steadily maintained. Eight bales per minute is considered as a rapid pace. These two rates

Fig. 4 A bale-dragging test on a concrete surface. The subject follows a painted circle. The string speed is controlled with a variable-speed motor

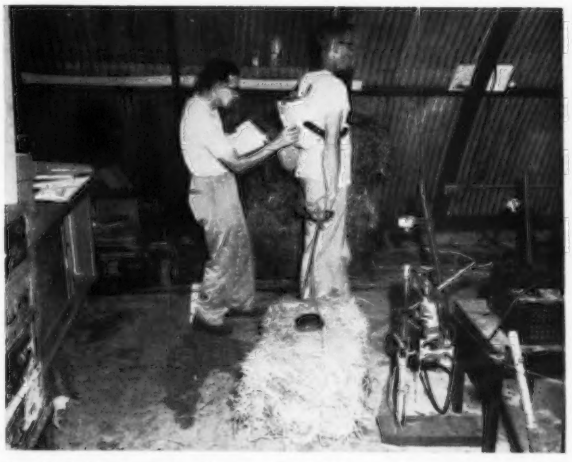

Fig. 5 Subject wearing face mask and gas meter. At termination of each test the respired-air volume readings are recorded

Fig. 6 Energy tests on bedding down an area with straw consisted of timing the subject while distributing two bales of straw over a designated area

were assumed representative of the range of normal stacking operations.

Three different lifting heights for stacking bales were used. They were 15, 30, and 45 in. which were approximately one, two, and three bales high, respectively.

The equipment used for determining the energy required to lift and stack bales is shown in Fig. 1. The work platform was 8 by 8 ft in plan and 42 in. high. A flight conveyor, shown in the foreground, was attached to the work platform. A horizontal conveyor, adjustable vertically to heights of 15, 30, or 45 in. above the work platform, was attached to the work platform as shown at the right in Fig. 1. A wooden slide for returning the bales to the floor was attached to the horizontal conveyor.

To duplicate a stacking situation, the horizontal conveyor was designed to be motionless until the subject had placed the entire weight of a bale on it. The electric-drive motor was fitted with switches and a two-second, time-delay mechanism so that the current to the drive motor was always shut off when the conveyor was unloaded. The conveyor was hinged at one of its upright supports and supported by a spring at the other. When the conveyor was unloaded, it was held out of contact with two microswitches which were in the open position. The spring was adjusted to allow the weight of a bale to close the switches. One of the switches served to control the circuit through the heater element of the two-second delay mechanism and the other was to break the motor circuit immediately after a bale was unloaded.

The complete flow of materials can be seen in Fig. 1. Bales were placed on the inclined flight conveyor at specified intervals of time by a person on the floor. When a bale reached the work platform, the subject picked it up by the binding strings, placed it on the horizontal conveyor and then stepped directly backward to be in position for the next bale. After a bale was placed on the horizontal conveyor, it was mechanically carried onto the inclined slide and returned to the original starting point. The bales of straw which were used in the stacking tests were wrapped in burlap bags to prevent shattering losses, with resulting changes in bale weight. The bales were calibrated to the desired weights of 45 and 65 lb by either removing some of the straw or by placing small metal weights inside the bales.

Each subject was tested ten times for each of twelve work levels involving combinations of three stacking heights, two speeds, and two bale weights.

Moving Bales Horizontally

The variables encountered in moving bales of hay or straw horizontally are *(a)* bale weight, *(b)* speed of movement, *(c)* method of handling, and *(d)* type of floor surface. The same two bale weights, 45 and 60 lb, as used for the stacking tests were used in this part of the investigation.

In moving a bale of hay or straw manually from one location to another, a person usually either picks it up, carries it in front of him, or drags it behind him. Therefore, these two methods, carrying and dragging, were investigated.

The walking surfaces usually encountered around the farmstead are firm, such as wood or concrete, or elastic, such as straw floors or bedded areas. For this study two types of floor surface were included. One was a concrete floor (Fig. 4) and the other was a baled-straw floor (Fig. 2) formed of baled oat straw stacked one bale high and as closely together as possible.

Two moving speeds for carrying or dragging bales over concrete surfaces were selected. They were 150 and 200 fpm. Only one of the speeds, 150 fpm, was used in moving the bales over the straw floor.

A traveling string, shown in Figs. 2 and 3, was used to set the pace for subjects moving bales horizontally. A circle with a diameter of 12 ft was laid out on the floor and pulleys were located at the one-twelfth points such that the length of the string was 37.25 ft. Another circle with a diameter of 14 ft and 10 in. was laid out concentrically with the first. The outer circle was used as the path of the subject. The circumference of the outer circle was 46.6 ft, and the string length was 37.25 ft; therefore, the ratio of subject speed to string speed was 5 to 4.

The circles painted on the floor and the traveling string are shown in Figs. 4 and 5. The pulleys were mounted on stands. The subject regulated his speed of travel by walking beside a painted portion of the string, which was propelled by a small universal electric motor. The speed of the motor, and thus the speed of the string, was regulated by means of a voltage regulator. The top of the drive pulley was divided into twelve wedge portions. A strobotac was used in conjunction with the voltage regulator to obtain the desired motor speed.

Figs. 4 and 5 show subject No. 3 during a dragging test on the concrete floor, Fig. 2 shows subject No. 1 doing a carrying test on the straw floor, and Fig. 3 a dragging test on a straw floor. Ten tests were conducted for each subject for each combination of bale weight, speed of movement, and type of floor surface.

Shaking and Distributing Straw

In bedding livestock with baled straw, it is necessary to break the bales open and to distribute the straw by some means over the area to be bedded. This part of the bedding-down chore was partially mechanized in some operations, particularly in the larger ones. Several mechanical devices, such as shredders, blowers and manure distributors, have been used with varying degrees of success. However, Kleis reported that manual distribution of baled bedding was employed on all of the 224 farms, using baled straw, which he studied. Some farmers distribute straw over an area with a fork and others do it with their hands. In the study reported in this paper, the latter method was used.

This portion of the investigation did not lend itself to rigid control procedures as did previous activity components. Baled oat straw was available in bale weights of approximately 40 to 50 lb each. It was not feasible to adjust the weights to a common value, nor was it possible to control the speed of distributing the straw over a specified bedding area. In the tests each subject was allowed to shake and distribute a given quantity of straw (two bales), for which both his energy expenditure and time of operation were measured. A floor area of approximately 300 sq ft in the shape of a square, was used as the distributing area. Two bales of straw were weighed and placed in baled form in the middle of the test area. The subject was instructed to break open both bales and then work at a steady comfortable rate until the straw was loose and uniformly distributed over the entire area. Subject 3 is shown in Fig. 6 during one of the straw distributing tests. The time required to complete

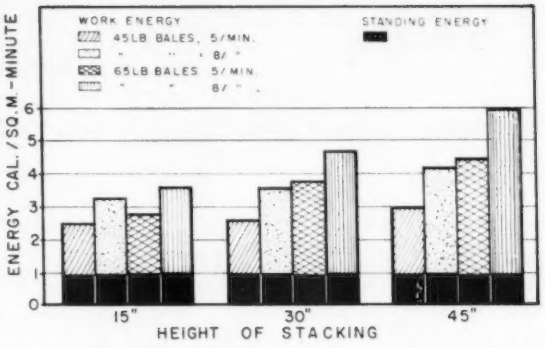

Fig. 7 Energy expended in lifting and stacking bales, based on body-surface area. (Average of ten tests for each of three subjects)

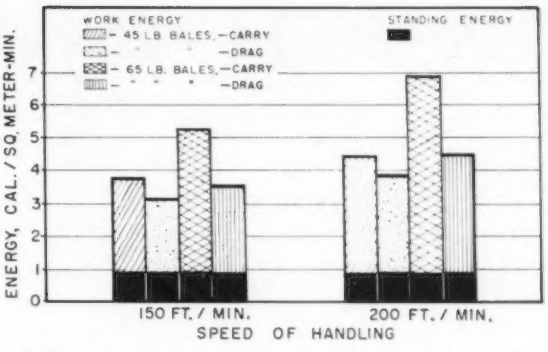

Fig. 8 Energy expended in carrying and dragging bales on a concrete floor, based on body-surface area. (Average of ten tests for each of three subjects)

the chore was recorded along with the energy measurements. Ten separate energy determinations were conducted for each subject.

RESULTS AND FINDINGS

In this study, total energy is the sum total of all the energy used by an individual performing a given chore. Work energy is the total energy minus the energy required by the subject for standing.

Uniform symbols are used on all the graphs. The total height of a column represents total energy; the black portion represents standing energy, and the difference between the two represents work energy. An analysis of the data showed that the variations between individual subjects were minimized by basing the data on expenditure per square meter of body-surface area. All the results are presented on this basis.

Stacking Bales

The composite results of the lifting and stacking tests are shown in Fig. 7. The average energy values for stacking 45-lb bales at five per minute for the three heights of 15, 30, and 45 in. were 2.44, 2.55, and 2.96 calories per square meter per minute. All of these averages were statistically different at the 95-percent level. This same energy expenditure pattern was true in stacking 65-lb bales at the slower rate of five bales per minute. The average energy expenditures for this chore were 2.77, 3.73 and 4.45 calories per square meter per minute for the respective heights of 15, 30, and 45 in. All of the averages were statistically different at the 99 percent level. Similar direct comparisons made for all combinations of energy expenditures show that the energies are all different for all different stacking heights.

In stacking 45-lb bales at eight per minute, 360 lb of material per minute were handled, and in stacking 65-lb bales at five per minute, 325 lb per minute were handled. As shown in Fig. 7, the energy expenditure was higher for the 45-lb bales stacked at eight per minute than for 65-lb bales at five per minute only for the 15-in. height. This perhaps could be expected at all heights since more material was handled per unit of time and more body movement was demanded at the high rate. However, at the 30 and 45-in. heights, more energy was required for stacking 65-lb bales at five per minute than for stacking 45-lb bales at 8 per minute. The differences are statistically significant at the 95 percent level.

If work energy is considered rather than total energy, the same general comparative picture emerges, except the differences between means are more pronounced. This comparison has the net effect of removing approximately 0.9 calories per minute per square meter (the average standing rate) from the total values.

Moving Bales Horizontally

The energy expenditures in carrying and dragging bales at two speeds on a concrete floor are shown in Figure 8. As shown in this figure, more energy is expended, at all speeds and bale weights, in carrying bales than in dragging them, and the differences are more pronounced for 65 pound than for 45 pound bales. Energy expenditure increased with speed for both dragging and carrying of bales. All of the total and work energy values are different from each other with the exception that carrying 45 pound bales at 200 feet per minute was not shown to be different from dragging 65 pound bales at 200 feet per minute, and carrying 45 pound bales at 150 feet was not shown to be different from dragging 65 pound bales at 200 feet per minute.

The energy expenditures in carrying and dragging 45 and 65-lb bales on a straw floor are given in Fig. 9. The data for carrying and dragging bales on the concrete floor at 150 fpm are also shown in this figure for comparative purposes. More energy was used for all bale weights and speeds on the straw floor than on the concrete. The differences be-

(Continued on page 518)

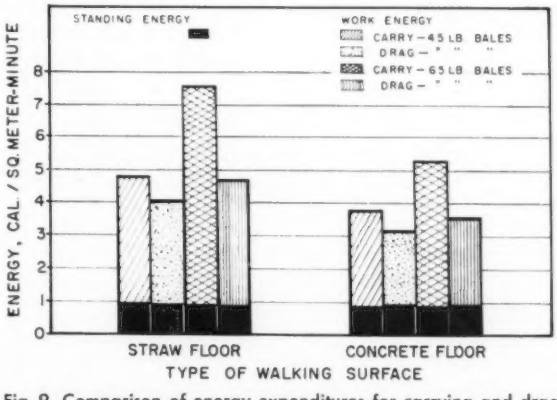

Fig. 9 Comparison of energy expenditures for carrying and dragging bales at 150 fpm on straw and concrete surfaces, based on body-surface area. (Average of ten tests for each of three subjects)

Two-Stage Reservoir Inlets

Melvin M. Culp
Member ASAE

An Important Tool When Properly Designed

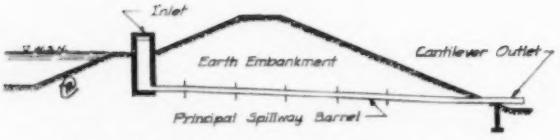

Fig. 1 Typical layout of a two-stage reservoir inlet

A TWO-STAGE reservoir inlet is an inlet in which the flow enters the inlet first at a low-stage opening (usually an orifice), and later, if the inflow into the reservoir is sufficient, at a higher stage. The discharge through the high stage is controlled first by weir flow, and later by full-pipe flow conditions in the drop inlet. Typical layouts of two-stage inlets are shown in Figs. 1 and 2.

Fig. 3, a graph of a typical stage-discharge curve for a two-stage inlet, illustrates its principal hydraulic characteristics. The flow from the reservoir is regulated by the low-stage orifice until the stage in the reservoir reaches the crest of the high-stage inlet. Then flow through the high-stage adds to the flow through the orifice until full-pipe flow is established.

The author conceived and designed the first two-stage inlets in 1946 for several structures on the Little Sioux flood-prevention project. The first subwatershed constructed on the Little Sioux project was the Nepper; it included a two-stage, drop-inlet spillway which was designed to facilitate grade control below the spillway. Other early subwatersheds in the Little Sioux which made use of two-stage inlets of the author's layout and design were the Theobold and the Mortenson, where again the principal use of this inlet was to reduce the discharge for most storms to values that could be carried at tolerable velocities in the channels below the structures, or which permitted an increase in the allowable grades between grade-control structures downstream.

The design and layout of the two-stage inlet has been improved and its characteristics extended to other important functional uses as the result of experience and careful contemplation of its basic characteristics and their application to other problems.

The principal uses and advantages of two-stage inlets as now used are:

1 In upstream flood prevention work the structure may be proportioned so that all floods up to those of a specific frequency are regulated by the low-stage orifice, or so that sufficient volume of the flood will be delayed by the storage between the low and the high-stage inlets that the peak discharge from the uncontrolled area below the retarding dams will pass successive downstream reaches before the increase in discharge through the high-stage inlet gets to these same successive reaches where damage is to be reduced.

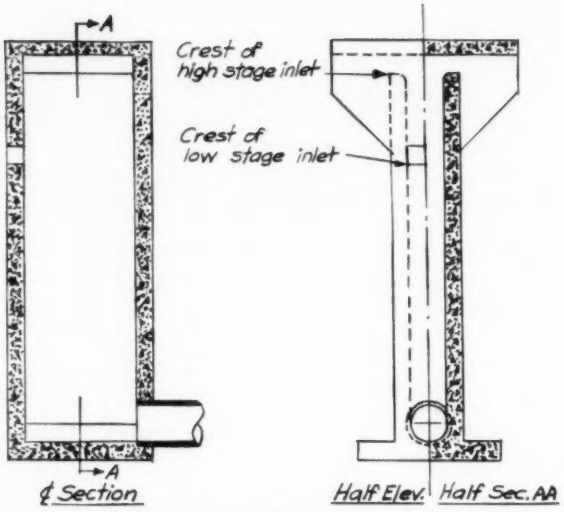

Fig. 2 Sectional views of a two-stage reservoir inlet

These design procedures result in more economical proportioning of retarding dams because they permit variation of the principal spillway capacity and of the storage in the reservoir and associated earth embankment costs, in such a way that the resulting retarding or multiple-purpose dam can be built at a minimum cost. In other words, it is unnecessary in many cases of upstream flood control to regulate all of a 25, 50, or 100-year flood at very low outflow rates in order to accomplish the economically justified flood control.

The design procedure might conform to the following pattern:

(a) The crest elevation of the low-stage inlet is established to provide the required sediment storage, plus any additional storage needed in the reservoir for beneficial use.

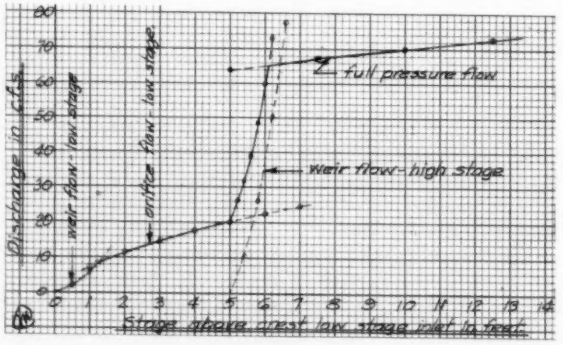

Fig. 3 Typical stage-discharge curves for a two-stage reservoir inlet

Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at College Park, Md., September 1959.

The author — MELVIN M. CULP — is chief, design and construction branch, Soil Conservation Service, USDA, Washington, D. C.

(b) The capacity and size of the low-stage inlet (usually an orifice in the riser wall) is determined to satisfy downstream flood control, or stream-channel stability requirements. Any practical discharge through the low-stage inlet rapidly becomes insignificant in comparison with discharges from the uncontrolled area below for channel cross sections progressively further away from the retarding dam. It is common practice to design the capacity of the low-stage inlet for values in the range of 5 to 25 cu ft per second per square mile of drainage area (CSM). There is nothing sacred about this range of values. In a complete cost analysis, the effect of discharge through the low-stage inlet should be included in the analysis of channel cross section, grade, excavation and cost for the damage reaches in relation to estimated damages and justifiable benefits. Seldom should the discharge capacity of the low-stage inlet be less than 5 CSM, and it might well exceed 25 CSM in specific cases.

(c) The crest elevation of the high-stage inlet is established by routing a flood of a given frequency or required volume through the reservoir and the low-stage inlet. The maximum stage attained in the reservoir during passage of this flood is the minimum elevation of the crest of the high-stage inlet.

(d) For most upstream retarding dams, the emergency spillway is a vegetated earth spillway. Its minimum crest elevation is established for any particular size of the principal spillway by routing the principal spillway hydrograph through the reservoir and the principal spillway. The maximum elevation of the water surface in the reservoir attained during passage of this particular inflow hydrograph is the minimum elevation of the crest of the earth spillway. The principal spillway hydrograph is chosen so as to prevent flow in the emergency spillway for all storms below those of a certain frequency or magnitude. For example, if the principal spillway hydrograph truly represents a 2 percent chance flood, the emergency spillway will not be brought into operation on the average of more than twice in 100 years. In the author's judgment, this is as often as an earth spillway of a retarding dam should be brought into use.

The maximum elevation of the water surface in the reservoir attained during the passage of the principal spillway hydrograph will depend upon the discharge capacity of the principal spillway. If the capacity of the principal spillway is increased, the crest elevation of the emergency spillway is lowered and the volume of earth in the embankment is reduced. Thus a comparative cost study can be made in which the principal variables are the size of the principal spillway barrel and the cost of the structure.

For retarding dams with earth spillways (not in rock) the difference in elevation between the crest of the emergency spillway and the top of the settled earth dam embankment usually varies between the relatively narrow limits of about 3.5 to 5.0 ft. The exact value is dependent primarily on the permissible velocity at the control section of the emergency spillway and the profile and length of the inlet channel of the emergency spillway.

A comparative cost study is the only sound way of determining the particular size or capacity of the principal spillway which will accomplish the functional purpose of the structure at a minimum cost. It should be evident that, without the use of a two-stage inlet, such a cost study would be impossible for it was by means of the two-stage inlet that we were able to vary the capacity of the principal spillway, one of the principal variables in the cost study.

A two-stage inlet is not necessarily the correct solution to a particular problem but a cost analysis such as proposed above will determine whether or not it is the proper solution.

In flood-retarding dams, a two-stage inlet can be of very real help in regulating the time required to dewater the flood pool. In some cases where single-stage inlets with low discharge capacity have been used, the time required to bring the water surface back to the normal pool after a storm has been too long.

The result has been that succeeding storms have produced flow through the emergency spillway much more frequently than would have been the case had a properly proportioned two-stage inlet been used.

Another significant fact to be considered is that, for many watersheds where the damages are primarily agricultural in nature, as much as 85 to 95 percent of the potential benefits can be achieved by controlling floods of 5 to 10-year frequency or less. Seldom will it be economically sound in such circumstances to provide for a higher level of protection than for a 5 to 10-year frequency flood. This general conclusion is verified by years of drainage experience. Control of a 5 to 10-year flood between the low and the high-stage inlets will provide the required regulation of the flow from the controlled area of the watershed without consideration of the lag time generated by the storage and low outflow rates associated with discharge through the low-stage inlet.

2 The second principal use of the two-stage inlet is in connection with the design of retarding dams placed above channels that are unstable and eroding. The erosion may be in the form of bank erosion, gully degradation or head cutting (overfalls moving up the channel). In such cases where it is necessary to stabilize the channel either by vegetation or structural control, a retarding dam or a multiple-purpose grade control and retarding dam located near the upstream end of the eroding channel can be very helpful. In this situation, a two-stage inlet may be particularly helpful since it permits a major reduction in the peak rate of discharge to be carried by the channel for a major part of the total volume of flow which will pass the dam. This is particularly true where the channels are such that out-of-bank or flood plain flow seldom occurs. Regulation of the discharge through the low-stage inlet is a powerful tool in the control of velocity in the channel downstream. Many variations of this basic concept are possible. We still have much to learn about the use of this device, but its use for this purpose has demonstrated that it works.

3 Another advantage of the two-stage inlet is that its use permits the safe use of a covered inlet such as illustrated in Fig. 3. This covered inlet and the associated trash guard layout is the most effective antivortex device and trash guard being used today for drop-inlet spillways. I strongly recommend its use with two-stage inlets.

The two-stage inlet is a powerful tool when used wisely and with proper design. It is not a panacea. In my judgment, it has not been used enough.

One Way to Lower Tractor Power Costs:

Operation at Optimum Engine Speeds

S. G. Huber and B. J. Lamp
Member ASAE *Member ASAE*

FARMERS are interested in finding ways to reduce tractor power costs. These can be achieved through better care and maintenance, proper selection, and optimum operation.

Importance of proper maintenance has been recognized by farmers and others for many years. To guide operators, manufacturers and their representatives, farm magazines and agricultural agencies have made available considerable information concerning recommended and adequate maintenance practices.

However, there is less information published concerning proper selection and optimum operation of tractors (1, 2, 3, 4, 5, 6).* Nebraska tractor tests offer answers to many questions concerning performance of individual tractors at or near full-throttle governed speeds. However, performance at less than full-throttle operation cannot be established from these tests. The need for tractor performance data at part-throttle speeds has become increasingly important in recent years as more powerful tractors with many forward speeds have become available.

It is the purpose of this paper to report results of a study which provided information concerning efficiencies of tractors at various engine speeds and loads and to indicate how the data may be used for improved selection and operation of tractors.

PROCEDURES

Five gasoline and three diesel tractors were tested on a traction dynamometer under full and part-throttle conditions of operation. The gasoline tractors ranged in size from 24 to 50 hp; the diesels, 29 to 44 hp. Prior to testing, adjustments were made according to manufacturers' specifications. Carburetors were adjusted to conform with settings used in Nebraska Test C.

Tractors were positioned with their rear wheels setting on and driving four-foot diameter drums directly connected to an electric dynamometer. Tractors were anchored to the floor through their drawbars.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division.

The authors — S. G. HUBER and B. J. LAMP — are, respectively, associate professor and extension agricultural engineer, and associate professor of agricultural engineering, Ohio State University, Columbus.

*Numbers in parentheses refer to the appended references.

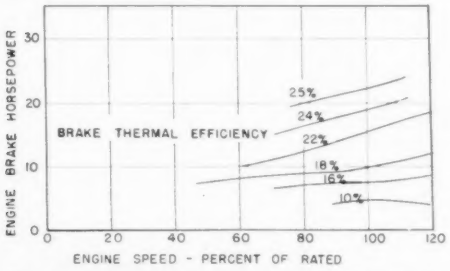

Fig. 1 The effect of engine speed and load on brake thermal efficiency — 24-hp gasoline tractor

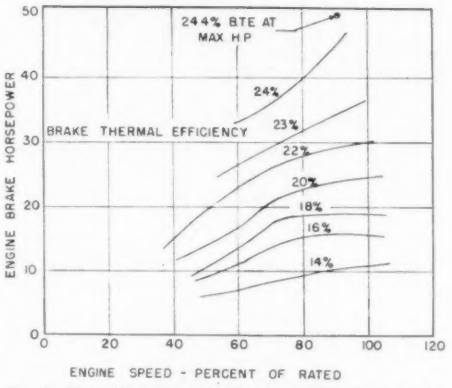

Fig. 2 The effect of engine load and speed on brake thermal efficiency — 50-hp gasoline tractor

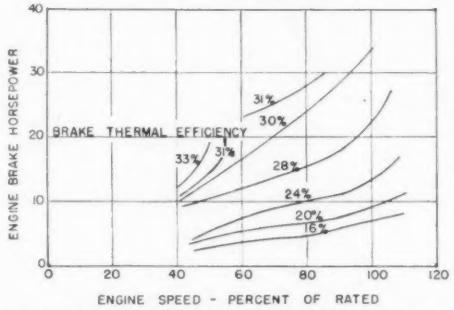

Fig. 3 The effect of engine speed and load on brake thermal efficiency — 34-hp diesel tractor

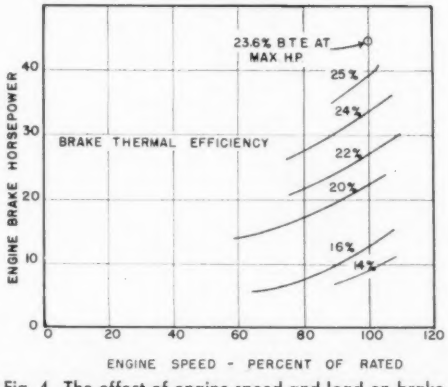

Fig. 4 The effect of engine speed and load on brake thermal efficiency — 44-hp diesel tractor

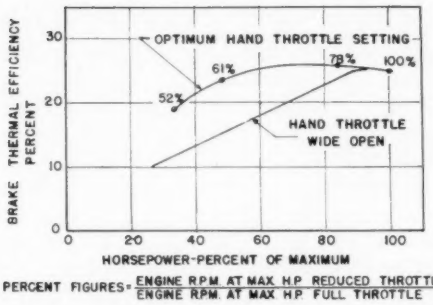
BRAKE THERMAL EFFICIENCY PERCENT
OPTIMUM HAND THROTTLE SETTING
52%
61%
78%
100%
HAND THROTTLE WIDE OPEN
HORSEPOWER-PERCENT OF MAXIMUM
PERCENT FIGURES = ENGINE R.P.M. AT MAX. H.P. REDUCED THROTTLE / ENGINE R.P.M. AT MAX. H.P. FULL THROTTLE X100

Fig. 5 The effect of optimum hand-throttle setting on brake thermal efficiency — 24-hp gasoline tractor

The load on each tractor was varied from zero to values reaching maximum power at full load and at least three part throttle positions of the hand throttle. Governors were operative at each hand-throttle position. Horsepower delivered to dynamometer, fuel consumption, and slippage data were recorded for all tests.

Horsepower loss through the transmission and tires was measured by motoring with the dynamometer. Engine brake horsepower was the sum of horsepower observed at the dynamometer and horsepower loss in transmission.

Brake thermal efficiencies were calculated on a heat content per pound of 20,500 and 19,700 btu for gasoline and diesel fuels, respectively.

RESULTS

Effect of Engine Speed and Load on Efficiency

Typical thermal efficiencies are shown in Figs. 1 through 4 at various conditions of speed and load for two gasoline and two diesel tractors. From these figures, it is apparent that

(a) At constant engine speed, efficiency increases with increasing horsepower (torque)

(b) At constant horsepower, efficiency increases with reducing engine speed.

The effect of engine speed on thermal efficiency is presented in Figs. 5 through 12. Curves labeled "hand throttle, wide open" indicate the relationship between power and thermal efficiency at open throttle, governed speed. Curves marked "optimum hand-throttle setting" present the maximum efficiency obtainable through reducing engine speed. Numbers on the "optimum hand-throttle setting" curves

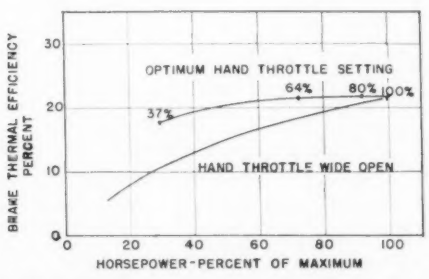

Fig. 6 The effect of optimum hand-throttle setting on brake thermal efficiency — 28-hp gasoline tractor

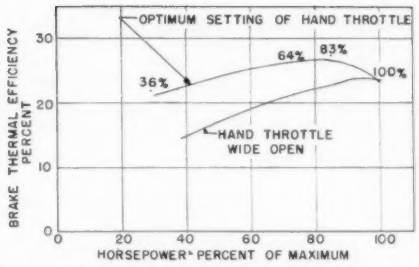

Fig. 7 The effect of optimum hand-throttle setting on brake thermal efficiency — 35-hp gasoline tractor

indicate the percent engine speed is at that point of rated engine speed.

Best efficiency at full-throttle governed speed occurred at 90 to 100 percent of maximum power. Frequently, however, a greater efficiency was obtained at reduced engine speeds (Figs. 7, 10 and 11). By reducing engine speed, it was possible to obtain efficiencies equal to that obtained at maximum power at outputs down to one-half of maximum power.

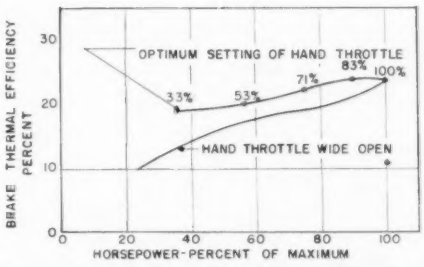

Fig. 8 The effect of optimum hand-throttle setting on brake thermal efficiency — 38-hp diesel tractor

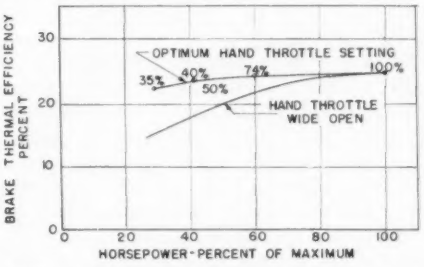

Fig. 9 The effect of optimum hand-throttle setting on brake thermal efficiency — 50-hp gasoline tractor

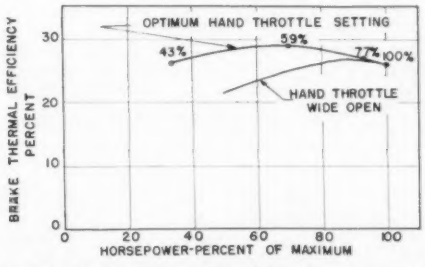

Fig. 10 The effect of optimum hand-throttle setting on brake thermal efficiency — 29-hp diesel tractor

. . . Lower Power Costs

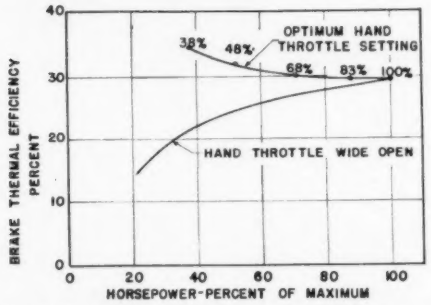

Fig. 11 The effect of optimum hand-throttle setting on thermal efficiency — 34-hp diesel tractor

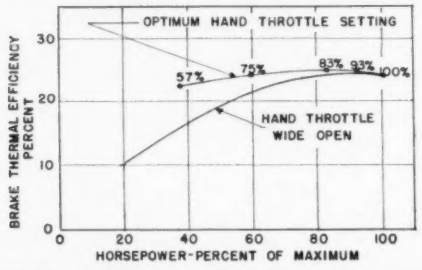

Fig. 12 The effect of optimum hand-throttle setting on brake thermal efficiency — 44-hp diesel tractor

Effect of Fuel Type on Thermal Efficiency

Diesels generally had higher thermal efficiencies than gasoline tractors. Ranges were 21.9 to 25.0 percent, and 23.9 to 29.6 percent for gasoline and diesel tractors, respectively, at maximum power.

Diesel tractors showed less improvement in thermal efficiency at reduced-throttle, optimum engine-speed settings than gasoline tractors. Nevertheless, part-throttle diesel efficiencies were higher than those of gasoline tractors.

Effect of Tractor Size on Thermal Efficiency

In these tests there was found to be no consistent relationship between tractor size and thermal efficiency. The smallest gasoline tractor yielded the highest thermal efficiency of gasoline tractors. The intermediate-sized diesel was more efficient than the larger and the smaller diesels.

Smaller tractors generally exhibited a greater improvement in brake thermal efficiency than larger tractors did when operated at part-throttle loading. This gain was more pronounced at lighter loads.

DISCUSSION OF RESULTS

Thermal efficiency is the product of the following efficiencies: combustion efficiency (or efficiency of converting the potential energy of the fuel into heat), conversion efficiency (the conversion of the heat into indicated work at the piston), and mechanical efficiency (percent of indicated work delivered to the clutch).

If the same horsepower is to be developed as engine speed is reduced, torque must be increased. This will result from the governor opening the carburetor butterfly or the fuel injector. For gasoline engines, higher compression and reduced intake work will result. Both improve conversion efficiency.

The combustion efficiency probably remains about the same in both diesel and gasoline engines.

Mechanical efficiency will be improved in both because engine friction decreases with reduced engine speed. Since conversion efficiency should not be greatly changed with the diesels, gains in thermal efficiencies should be greater with gasoline engines as results indicated.

If speed remains constant and horsepower is increased by increasing torque, the gain in thermal efficiency results largely through improved mechanical efficiency. Mechanical efficiency improves because the loss through friction becomes a smaller percentage of total indicated work. Conversion efficiency improvement in the gasoline engine also contributes to improved efficiency.

APPLICATION OF RESULTS

Fuel consumption at various horsepower levels at wide open and optimum settings of hand throttle are shown in Table 1 for four tractors. The actual savings resulting to a farmer would depend on his ability to select optimum speed. Few farmers would be able to gain the savings shown, since these are the maximum possible.

TABLE 1. FUEL CONSUMPTION AT VARIOUS HORSEPOWER LEVELS WITH WIDE-OPEN AND OPTIMUM SETTINGS OF HAND THROTTLE

Load horse-power	Gallons of fuel per hour							
	24 hp gasoline		50 hp gasoline		34 hp diesel		44 hp diesel	
	Optimum	Wide	Optimum	Wide	Optimum	Wide	Optimum	Wide
5	0.68	0.92	—	—	0.35	0.68	—	—
10	0.92	1.19	1.07	1.56	0.54	0.95	0.98	1.36
15	1.25	1.52	1.38	1.93	0.80	1.18	1.21	1.64
20	1.62	1.74	1.81	2.20	1.14	1.37	1.61	1.94
30	—	—	2.59	2.95	1.71	1.83	2.16	2.41
40	—	—	3.35	2.45	—	—	2.83	2.83

A hypothetical tractor work life was selected based on a total life of 12,000 hr. Total fuel savings over the life of four tractors was calculated for optimum and wide-open throttle settings. Fuel savings varied from 9.9 to 31.4 percent (Table 2).

Tables 1 and 2 can be used to establish the effect of tractor fuel, tractor size, and method of operation upon fuel consumption.

TABLE 2. FUEL SAVINGS BY USING OPTIMUM RATHER THAN WIDE-OPEN SETTINGS OF HAND THROTTLE OVER A 12,000-HR WORK LIFE

Tractor	Fuel Savings	
	Gallons	Percent
24 hp gasoline*	2760	16.3
34 hp diesel*	4170	31.4
50 hp gasoline†	3790	11.7
44 hp diesel†	2700	9.9

*Work load — 1,000 hr, 5 hp; 4,000 hr, 10 hp; 4,000 hr, 15 hp; 3,000 hr, 20 hp.

†Work load — 1,000 hr, 10 hp; 4,000 hr, 20 hp; 4,000 hr, 30 hp; 3,000 hr, 40 hp.

CONCLUSIONS AND SUMMARY

The following conclusions may be reached from the study reported in this paper:

(a) Major gains are possible in engine thermal efficiencies by selecting optimum engine speeds

(Continued on page 519)

Bulk Curing of Bright Leaf Tobacco

A curing operation compatible with mechanization

W. H. Johnson, W. H. Henson, Jr., F. J. Hassler, and R. W. Watkins
Member ASAE Member ASAE Member ASAE Assoc. Member ASAE

A PROBLEM inherent to the conventional methods of tobacco production is the great amount of hand labor required. Some mechanization has been achieved, particularly in cultural operations, but approximately 420 man-hours per acre are still necessary in tobacco production, according to the agricultural economics department of North Carolina State College. This is based on a tobacco allotment of 4 to 5 acres and a yield of 1800 lb per acre. Approximately three-fourths of the total labor is required in the harvesting and processing operations.

Present mechanical harvesters have not been successful in the solution of this problem. It is true that a measure of convenience has been introduced, such as conveying the field workers, and that the number of leaf handlings has been slightly reduced. According to Chumney and Toussaint (1)*, labor reduction in machine harvesting comes about largely through the elimination of a single harvesting operation — handing. However, all other essential operations (priming and looping) are retained. Progress notwithstanding, high labor requirements still exist. Furthermore, it is recognized that individual leaf-handling operations, essential for the conventional curing method, are the bottlenecks to the development of mechanical complements for eliminating hand labor in harvesting and processing. These operations, however, because of their complexity in terms of requirements for selectivity, orientation, and timing, present a real challenge to practical mechanization.

Systems engineering, which is concerned with over-all processes, involves application of new operational techniques with maximum efficiency. Since the inherent difficulties to advancing tobacco mechanization reside with the conventional curing method, past research at North Carolina State College has been directed towards the development of a curing operation which would be more compatible with over-all mechanization. Results suggested the possibility of curing packed leaves, and by this approach eliminating the requirement for stringing leaves on a stick. Based on this conclusion, research and development have been initiated to test the feasibility of a curing method referred to as "bulk curing."

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*Numbers in parentheses refer to the appended references.

REVIEW OF LITERATURE

The development of the bulk-curing process, radically different from the conventional as described by Brown and Weldon (2), was a gradual evolution based upon accumulated observations and measurements of a fundamental nature. Studies by Hassler (3, 4) provided limits for environmental control and information helpful to proper yellowing of leaf tissue. Using a thermocouple inserted between the layers of leaf tissue, he studied the phenomenon of color change as influenced by temperature, drying rate, and leaf moisture content. Concerning browning reaction he stated: "The rate of browning (sponging) was found imperceptible below 110 F, but the reaction speeds up with increasing temperature, becoming sufficiently rapid at 135 F to produce total discoloration within six minutes. Thermal killing of the enzyme system that produces the browning reaction was obtained within one second at 212 F." These tests showed the necessity of maintaining leaf temperatures consistent with requisite biochemical changes and moisture content in order to produce a satisfactory cure. Drying of the leaf to 75 to 80 percent of its initial moisture content was also found desirable for hastening the green to yellow color change.

The impetus for curing in the bulk led to detailed studies on bulk yellowing by Henson *et al* (5) who investigated the conditions existing in ventilated and non-ventilated bulks of tobacco and evaluated the influence of these conditions on certain chemical and physical properties of the cured leaf. In the non-ventilated bulks, temperatures increased almost linearly with time for 35 to 51 hr after the leaves were bulked and reached peaks of 125 to 129 F. Almost two-thirds of the tobacco was damaged by these high bulk temperatures which resulted from heat of respiration. Ventilation of bulks with air velocities of 25 fpm prevented temperature damage and resulted in yellowed tobacco having good color and physical appearance. Chemical analyses showed that bulk yellowing could be accomplished without appreciable reduction of total and reducing-sugar contents, provided forced air was employed to prevent temperature damage.

Johnson *et al* (6) studied the edge effects which resulted from shredding tobacco during the green stage. Results illustrated that edge effects from shredding green tissues were negligible when the tobacco was yellowed in a low-drying environment of 96 percent relative humidity. However, drying conditions of 82 percent relative humidity during yellowing amplified edge effects by producing premature arrestation of certain biochemical reactions along the cut edges. Under properly controlled temperature and humidity conditions, shredded tissue was predicted to yellow to good color in a bulk with negligible edge effects.

A further study by Johnson *et al* (7) showed that bruising adversely affected both appearance and sugar levels of

green tobacco tissue. Bruising of green tobacco tissue prevented normal chlorophyll disappearance and impeded the conversion of starches to sugars which normally occurs during yellowing. These results showed that, in order to maintain a quality product, non-bruising methods of handling must be used in the development of new approaches in mechanizing harvesting and curing operations.

EXPERIMENTAL

Laboratory Investigations, 1956

During 1956, laboratory studies were conducted to further evaluate the potentialities of bulk curing. Objectives for the experiment were:

(a) To make chemical and physical evaluations of both intact and shredded bulk-cured tobacco in comparison with conventionally cured tobacco, and

(b) To make measurements pertinent to the design and construction of equipment for bulk curing.

Three bulk-curing chambers of the design shown in Fig. 1 were constructed for the initial tests of 1956. Each chamber consisted of a centrifugal fan, a conical section, and a cylindrical section. A metal mesh screen located between the cylindrical and conical sections provided support for approximately 200 lb of uncured intact tobacco. This particular design was selected because it was considered that a circular chamber would provide uniform air distribution with simplicity of design. Heat was furnished by a jet-type gas burner which was fired directly into the fan. The temperature within the conical section was thermostatically controlled by an on-off valve in the gas line, actuated by a sensing bulb located within the cone. A multiple-point temperature recorder registered the temperatures of thermocouples located in the air inlet and in the bulk. Air volume rates were determined by measurements with pitot tubes positioned beneath the tobacco.

Six tests were conducted throughout the harvesting season in which both intact leaves and leaf material shredded in ½-in. strips were cured in cylindrical chambers, while check samples were cured conventionally for comparison. In loading intact tobacco, the chambers were tilted and the tobacco was placed uniformly by the handful into the chambers, keeping the butts oriented in the same direction. Shredded material was uniformly placed into the chambers by hand to a depth of 15 to 17 in. above the screen.

Schedules for the initial bulk-curing tests differed markedly from the conventional curing schedules. In conventional curing, yellowing was accomplished in a 90 to 100 F environment. After yellowing, the temperatures were increased gradually to 130 to 140 F to "set" the color and to dry the leaf, then raised gradually to 170 F to finish drying the leaf and midrib. With bulk curing, however, no external heat was used during yellowing. Exothermic reactions of respiration caused bulk temperatures to gradually increase; therefore, it was necessary to aerate the bulks in order to maintain bulk temperatures below 100 F. Aeration was accomplished by using a liquid-filled sensing bulb which actuated an on-off microswitch in the fan circuit whenever the bulk temperature exceeded 100 F. After yellowing, two temperatures were used for drying the tobacco — 130 F for 8 to 15 hr and 170 F until the leaf was completely dry.

Observations during the initial tests showed many aspects of bulk curing that needed improvement. The irregular air flow and temperature schedules during bulk yellowing gave a non-uniform yellowing environment; also, the rapid temperature increases appeared to produce discoloration. It was observed that a limited amount of drying during yellowing would be desirable for preventing surface-moisture accumulation within the tightly bulked tobacco and also for promoting more favorable yellowing conditions. More uniform air distribution was obtained when the leaves were supported with the butts upward and with air flow from the tip end to the butt end. Furthermore, this gave the advantage of drying in the same direction as yellowing, i.e., from tips to butts. Non-uniform air distribution, which resulted in uneven drying and lowered quality, was considered to be a major problem to the advancement of bulk curing. Since uniformity of air distribution depends directly on bulk uniformity, the non-uniform loading method employed caused air channeling through less dense sections of the bulk. Tightly packed sections, which dried last, were consequently damaged by high bulk temperatures. Comparisons of energy efficiencies showed that bulk curing using forced convection was only one-third as efficient as conventional curing, since a large amount of sensible heat was discharged from the bulk chambers.

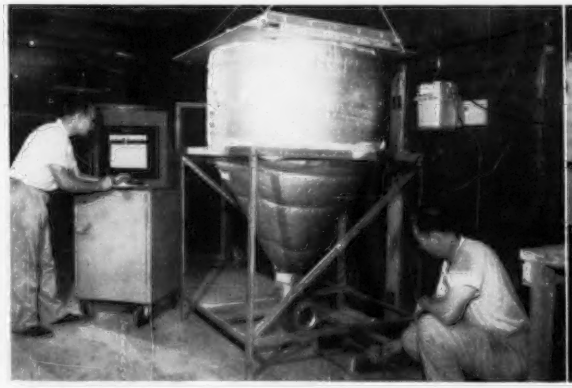

Fig. 1 Apparatus for the initial experiments on bulk curing • Fig. 2 Climatic chamber used in the laboratory testing of bulk curing

Physical evaluations of the cured tobacco showed no apparent differences in color among samples of tobacco that were conventionally cured, shredded bulk cured, and intact bulk cured (from less dense sections of the bulk). However, the bulk intact tobacco exhibited a flat, unnatural appearance while shredded tobacco had an abnormal and undesirable aroma.

Laboratory Investigations, 1957

From the above observations, the additional objectives were added to the following 1957 experiment:

(a) To make improvements in the loading techniques and equipment which would simplify the process and contribute to curing a more acceptable and higher quality product.

(b) To improve the curing schedule and develop techniques of recirculation for improving process efficiency.

Six climatic chambers of the type shown in Fig. 2 were used to provide a controlled environment and to accommodate an improved loading technique. Electronic temperature controls maintained conditions within 1 F, while airflow and recirculation dampers allowed any desired air movement. A steam supply to the chambers provided a positive method for maintaining high humidities during yellowing as well as for conditioning the tobacco after curing.

An improved loading method contributed to faster, easier bulking, and allowed much greater uniformity in packing of tobacco within racks. The loading rack consisted of two wooden members constructed of 2 x 4 x 48-in. material. One member had a series of ⅜-in. metal rods spaced at 6-in. intervals along the rack to provide support for the tobacco. In principle, a side member of the loading rack, without the rods, was placed in the bottom of a loading form which was similar to a box with an open top and front. After tobacco had been placed to a given height in the form (by the armful or handful), a second side member of the loading rack was connected to the first side member, thereby clamping the tobacco in a rectangular shape, 16 by 48 in., and at the same time piercing the tobacco with the rods. A filled rack of tobacco is shown in the chamber of Fig. 2. Each chamber held two racks of intact tobacco (160 lb) or one metal basket of shredded tobacco (100 lb).

Six tests were conducted throughout the harvesting season in which bulk tobacco was cured with three replications in climatic chambers, while check samples were cured conventionally for comparison. Temperature schedules for bulk curing followed closely those for conventional curing. Airflow and recirculation schedules for bulk curing were designed to improve the efficiency.

As a result of these modifications in equipment and improvements in the controls, noticeable improvements were recognized in the quality of cured intact tobacco. Visual observations showed no apparent color differences between tobacco cured in the bulk and that cured conventionally. The appearance of tobacco cured in the bulk was greatly improved over that cured in 1956, and much of the objectionable flat appearance was overcome by adequately conditioning the tobacco after curing. Shredded tobacco, however, still continued to exhibit an undesirable aroma. As a consequence of the improved loading technique, uniform air distribution and even drying resulted, thus maintaining quality by proper drying. In addition to upgrading quality, fuel efficiencies for bulk curing surpassed conventional curing as a result of proper recirculation of air.

TABLE 1. RESULTS OF CHEMICAL ANALYSES FOR LABORATORY BULK CURING, 1956-57*

	1956	1957
Total Sugar Percentage		
Conventionally cured	32.24	28.77
Intact bulk cured	31.88	28.45
Shredded bulk cured	29.04†	24.44†
Reducing Sugar Percentage		
Conventionally cured	27.30	23.53
Intact bulk cured	27.23	23.30
Shredded bulk cured	21.85†	18.84†
Nicotine Percentage		
Conventionally cured	2.04	3.43
Intact bulk cured	1.93	3.55
Shredded bulk cured	1.70†	2.84

*Analyses performed by North Carolina State College Tobacco Laboratory — 1956 analyses, average of 12 samples
1957 analyses, average of 18 samples
†F test exceeds the tabular F at the 1 percent level of significance.

Results of sugar and nicotine assays by the North Carolina State College tobacco laboratory on representative samples of tobacco from 1956 to 1957 tests are shown in Table 1. In every case, shredded tobacco had lower contents of sugar and nicotine while intact, bulk-cured leaf did not differ significantly from normally cured leaf. Chemical evaluations by several tobacco companies agreed closely with the results of Table 1. Moreover, shredded tobacco had significantly smaller contents of total alkaloid and petroleum ether extract but larger ash content and specific volume. Although the importance of each chemical component is uncertain these significant differences were considered undesirable.

Smoking tests were conducted by several tobacco companies on tobacco samples from the 1956 and 1957 curing experiments. Consistently the results showed that bulk-cured leaf was similar in smoking characteristics to that cured by the conventional method. Shredded tobacco, however, produced an undesirable smoke which lacked flavor and had an acrid aroma.

Results obtained in bulk curing of intact leaf, from the standpoint of operation and quality of cure, suggested the initiation of the development of a practical bulk-curing system. On the other hand, negative results in bulk curing of shredded tobacco suggested more fundamental research to find ways of improving its curability.

Pilot Operation, 1958

An applied study in bulk curing of intact leaf was conducted, in which laboratory findings and techniques were extended to encompass a pilot operation, intermediate between laboratory and field operations. The design and operation of this curing system were concerned with simplifying the loading and unloading of racks of tobacco, adopting airflow and temperature schedules which enhance the quality of the cured product, and obtaining maximum operational efficiencies.

Fig. 3 shows a schematic drawing of the curing system. It consisted essentially of a curing compartment for bulked tobacco, a thermostatically controlled heating furnace (indirectly gas fired), and a dampered duct for regulating the amount of air to be recirculated. To simplify the operation of loading the racks of bulked tobacco into the barn, the structure was designed so that two men standing on the floor of the barn could lift the racks of tobacco onto the

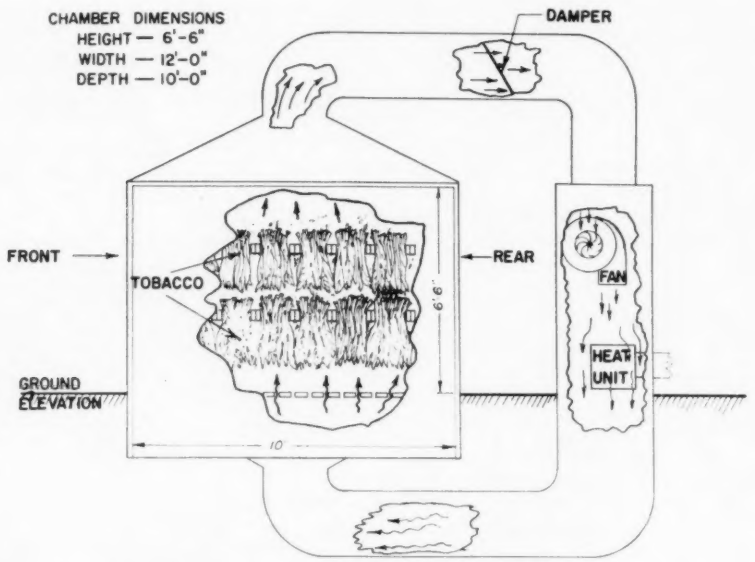

Fig. 3 Schematic of pilot stage bulk-curing system

EXPERIMENTAL MODEL OF BULK CURING CHAMBER

tiers. An essential feature of this system is the forced air movement. Hot air, forced up through the compartment floor and through the racks of tobacco at rates from 15 to 30 fpm, promoted drying and prevented "scalding" of the tightly packed tobacco.

The loading technique used in the preceding laboratory tests was improved to allow more rapid clamping of tobacco into racks. As shown in Fig. 4, tobacco was placed uniformly into the loading form by the handful. By having the form balanced on two pivot points, it was possible to place an approximately equal amount of tobacco in each rack — the right amount indicated by a slight tilting of the form. Each rack, 6 ft in length and 16 in. wide, held approximately 120 lb of uncured tobacco. Twenty-eight racks of tobacco, required for filling the 10 x 12 x 6½-ft compartment (Fig. 5), equalled that normally placed on around 330 sticks for conventional curing. The actual space required for bulk tobacco was one-sixth of that required for conventionally strung tobacco.

Fig. 4 Placement of leaves in the loading form for bulking into racks

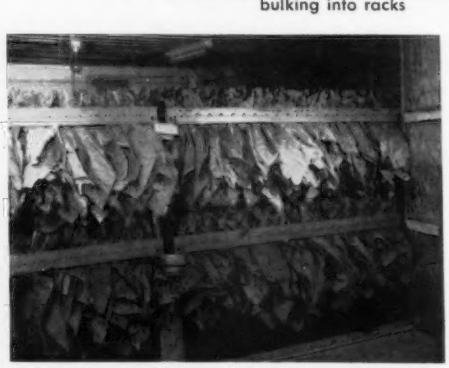

Fig. 5 Front view of bulk-curing compartment which holds 28 racks of tobacco

Six cures were conducted throughout the harvesting season of 1958 for comparing bulk curing with conventional curing. During yellowing, the temperature was held between 90 and 100 F with complete recirculation of the air. A temperature schedule similar to the conventional schedule was then followed (Fig. 6). Color was "set" during a gradual temperature rise to 130 to 140 F, then the temperature was advanced to 170 F for stem drying. Relative humidities ranged from 80 to 90 percent during yellowing and as low as 10 to 20 percent during leaf and stem drying. The damper setting for air recirculation was varied manually to obtain a drying environment consistent with the stage of curing.

Although a curing system may be operationally successful, it is recognized that acceptability of the cured product must precede the introduction of the system for practical application. Results from the pilot operation of bulk curing showed only slight differences in quality between bulk and conventional cured leaf. Chemical and smoking evaluations performed by a cooperating tobacco company are shown in Table 2. Percentages of nicotine, nornicotine, reducing sugar, and total nitrogen agreed closely for bulk and conventional curing. Smoking evaluations rated bulk-cured tobacco as having low flavor (mild) and conventionally cured tobacco as having low to medium flavor; both passed the flavor test as suitable for cigarettes. Samples of bulk-cured

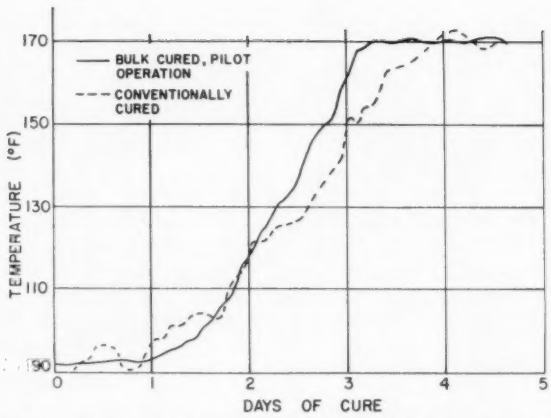

Fig. 6 Comparison of temperature-time schedules for bulk and conventionally cured tobacco (1958)

and conventionally cured leaves from the entire season were also graded according to USDA marketing standards. Average prices based on government grades were $58.70 per hundredweight for bulk-cured tobacco and $56.15 for conventionally cured tobacco. Representative samples of bulk-cured tobacco which were sold on the open market averaged $62, with a high of $70 per hundredweight.

TABLE 2. COMPANY "A" EVALUATION OF BULK AND CONVENTIONALLY CURED TOBACCO (1958)

	Intact bulk cured (Primings 2-6)	Conventionally cured (Primings 2-6)
Percent nicotine	2.65	2.59
Percent nornicotine	0.10	0.14
Percent reducing sugar	15.15	15.62
Percent total nitrogen	2.26	2.12
Smoking evaluation	Low flavor (mild)*	Low to medium flavor*

*Passed flavor test as suitable for cigarettes.

Indications are that the bulking method saved both time and labor in the barning operations. It is estimated, because of the rapidity and ease of filling the racks and placing them in the curing compartment, that barning labor (after cropping) was reduced by three-fourths, as compared with conventional methods. This figure was arrived at by comparing the total labor for stringing, handing, and loading a conventional barn with that required for bulking and loading an equivalent amount of tobacco for bulk curing.

DISCUSSION

Objectionable differences between the physical and chemical properties of shredded bulk-cured and conventionally cured tobacco are evidently related to the biochemical transformations occurring during the yellowing phase of curing. Reduction of various chemical components suggests an accelerated metabolic rate. Possible losses of aromatic oils or constituents through the cut edges could possibly account for the "different" aroma of the shredded tobacco. Then there is also the possibility that the curing environment adversely affected the chemical conversions of the leaf. Further research is necessary to determine whether tobacco can be cured in the shredded form to an acceptable state of quality.

The first experiments in bulk curing of intact tobacco produced leaves which were decidedly flat or pressed out in comparison with conventionally cured leaves. In later tests the appearance was greatly improved by adequately conditioning (ordering) the tobacco after curing; however, a detectable difference still remained. Bulk curing produces a somewhat flattened-out appearance because the leaves are held extended in the tight, compact bulks during curing. Conventionally cured leaves, which are strung loosely on sticks, are free to wrinkle and curl during the curing operation. Because of the similar results obtained in the chemical and smoking tests for bulk and conventionally cured tobacco, the somewhat flattened-out appearance is considered to be incidental to its utility for cigarettes.

Bulk curing of intact leaf has many possibilities for achieving marked advantages over the conventional curing method. The potential for producing a more uniform leaf is offered through automatic control of temperature and drying conditions. In addition to saving labor during barning, ease of unloading tobacco from racks speeds up the preparation for marketing. Bulk tobacco requires only one-sixth the curing space required by conventionally strung sticks. This suggests cost savings for basic curing structures, as well as the possibility of designing curing systems to accommodate the individual farmer's acreage. Fire hazard is virtually eliminated since the heating plant is exterior to the curing compartment. During 1958, fuel efficiencies were equivalent to conventional curing, although the damper for recirculating air was manually controlled. Therefore, a compact system for bulk curing, well insulated and automatically controlled, could surpass the conventional barn in efficiency. The curing system also lends itself to the use of a heat exchanger for recovering the heat normally lost through conventional barn ventilators.

SUMMARY

This paper describes the research and development of a curing operation which is more compatible with mechanization of bright-leaf tobacco than conventional curing. The feasibility of bulk curing was well established by laboratory studies during 1955-57.

During 1958 an applied study in bulk curing of intact leaf was conducted in which laboratory techniques and findings were extended to encompass a pilot operation, intermediate between laboratory and field operations. The curing system was designed for simplicity of loading and unloading racks of bulked tobacco, regulation of air flow and temperature schedules which enhance the quality of the cured product, and maximum operational efficiency.

Results of curing in the pilot operation show a possibility for acceptance of bulk-cured tobacco by the tobacco industry. Chemical results showed no significant differences between bulk (intact) and conventionally cured tobacco. Smoking tests rated bulk-cured tobacco as suitable for cigarettes. Representative samples of the bulk-cured leaf averaged $62 per cwt on the open market, with a high of $70 per cwt. Possibilities for achieving advantages over the conventional curing method are discussed.

The described engineering advancements in bulk curing are presently well adapted for conventional harvesting, but there is also the important possibility of integrating mechanical harvesting with bulk curing. Since many requirements for leaf selectivity and orientation in the barning operations are eliminated by bulk curing, this method offers simplifica-

(Continued on page 517)

INSTRUMENT NEWS

Method of Obtaining Continuous Measurements of Piezometric Heads

in Shallow Artesian Aquifers

W. C. Bianchi and Rhys Tovey
Assoc. Member ASAE

WATER-STAGE recorders are widely used in drainage studies to obtain information on the contributing water sources in areas of high water-table conditions. The time correlation of head fluctuations of a potential water source with fluctuations in the water table allows conclusions to be drawn regarding the nature and magnitude of the contribution of the water source to the poor drainage of an area. When the duration of the head change is too short to be measured by frequent reading of piezometers, the detection can be made only from continuous records.

The method of recorder placement outlined in this paper was developed in an area subject to high artesian leakage from an aquifer 7 to 16 ft below the ground surface. The Truckee River was established as the main source of recharge to this aquifer by correlating the occurrence of river-stage changes with stage records from recorders mounted on 6-in. unperforated casings augered down to the top of the aquifer. When attempting to determine the areal extent of the aquifer by time correlation of the occurrence of head changes from several locations, it was observed that good correlation was evident only after the irrigation and growing season had ended. The passage of water between the casing and the sides of the auger hole allows fluctuations in the water table, due to irrigation and evapotranspiration of the crop, to be transmitted to the float of the recorder. This effect was, in most cases, sufficient to mask any fluctuations of pressure in the artesian aquifer itself. The basic aim of this method, therefore, is to separate the water-table effects from those of the artesian aquifer by achieving a water seal between the two.

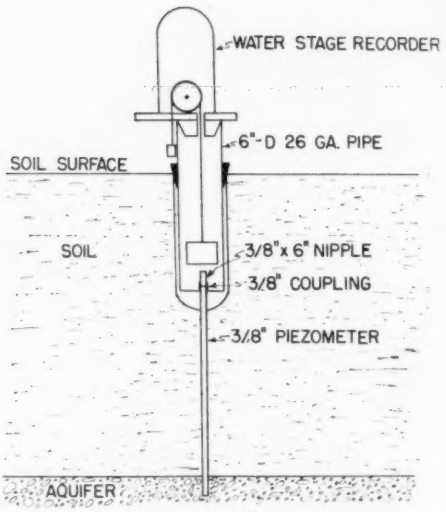

Fig. 1 Diagram of piezometer-recorder installation

Method

The following materials are required:

1 Sufficient ⅜-in. pipe to reach the desired depth in the profile and a rivet to place in the end of the line to prevent the entry of soil into the pipe as it is driven

2 A length of water-tight, 6-in., 26-gauge galvanized pipe, with one end sealed by a 20-gauge plate in which has been centered a ⅜-in. coupling with a 6-in. nipple on the inner side, thus forming a sediment trap (Fig. 1). The 6-in. pipe should be of sufficient length to allow for the expected range in displacement of the recorder float and an

An Instrument News Contribution. Articles on agricultural applications of instruments and controls and related problems are invited by the ASAE Committee on Instrumentation and Controls, and should be submitted direct to Karl H. Norris, instrument news editor, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

The authors — W. C. BIANCHI and RHYS TOVEY — are, respectively, assistant research soil physicist, department of soils and plant nutrition, University of Nevada, and agricultural engineer, soil and water conservation research division (ARS), USDA, Reno, Nev.

Acknowledgment: The assistance of Leslie L. Ede, soils student, University of Nevada, in helping to develop the method discussed in this paper is appreciated.

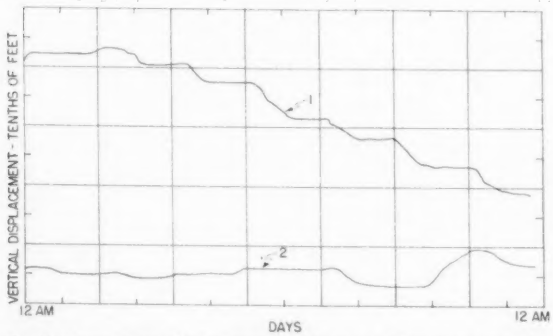

Fig. 2 Comparison of concurrent charts from a piezometer-recorder (curve 2) with a well installation-recorder (curve 1) showing the effectiveness of the piezometer-recorder in separating the head changes in the aquifer from water-table effects

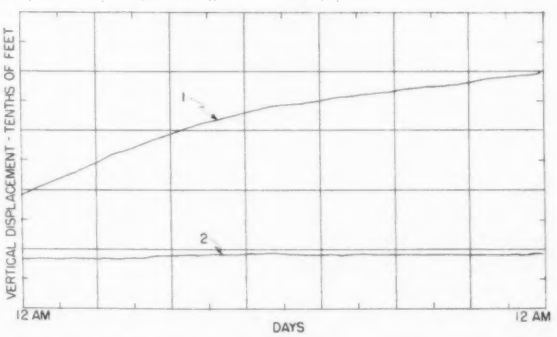

Fig. 3 Comparison of current charts from a piezometer-recorder (curve 2) and a well installation-recorder (curve 1) showing the effects of leakage from the aquifer on the two types of installations

additional 3 to 4 ft above ground for mounting the recorder and to allow for the travel of the float counterweight.

The following equipment is required:

1 A piezometer-driving hammer

2 A 6-in. closed-type posthole auger which has been modified to allow the passage of a ⅜-in. pipe up through the blades, shaft (¾-in. pipe), and cross fitting at the handle

3 A wire or rod of sufficient length to remove the rivet from the piezometer after it is driven

4 A small hand or gas-operated pump and a length of 3/16-in. Saran plastic tubing for flushing the piezometer

5 A water-stage recorder with float and platform for mounting on the 6-in. pipe.

Preparation

A previous knowledge of the seasonal-head variation is necessary in order to place the bottom of the 6-in. pipe deep enough in the profile to allow for the maximum-expected distance to the hydrostatic water level. The depth to which the piezometer is to be driven or the depth to the artesian aquifer must be determined prior to its placement. It is best to pick a location in the vicinity of an existing piezometer cluster so that these measurements can be made. The ⅜-in. pipe is then cut and threaded in such a manner as to allow the removal of the top section down to the depth at which the bottom of the 6-in. pipe is to be placed. All joints are tightened as the piezometer is driven, except the one at the point where the 6-in. pipe is to be attached. It is also desirable to place a length of ⅜-in. pipe on the nipple inside the 6-in. pipe to prevent the movement of material into the larger pipe when it is placed in the auger hole.

Placement Procedure

The plugged piezometer is driven to the desired depth, care being taken that the joint to be removed later is loose. The rivet is forced from the lower end of the piezometer with the wire or rod, and the upper end is plugged. The posthole auger is placed on the piezometer and a hole augered out around the ⅜-in. pipe to a depth of 6 to 8 in. below the point where the 6-in. pipe is to be attached. The upper section of ⅜-in. pipe is then removed and replaced with the 6-in. pipe. The 6-in. pipe can be filled with water to aid in lowering it into place. The piezometer is flushed out at this stage. This can be done by running the Saran tubing down the piezometer and pumping water through it. The ⅜-in. pipe in the center of the 6-in. pipe is removed and the stage recorder set in place.

Results

The effectiveness of this type of installation in separating water-table effects from head changes in an aquifer is shown in Fig. 2. Curve 1 is a week's record from a recorder on a cased well, augered down to the aquifer. An adjacent field was irrigated the preceding week, and the daily drop in the water table due to evapotranspiration is evident. Curve 2 is the chart for the same week from a piezometer setup 900 ft distant and in the same gravel. The steady upward leakage from the aquifer after the vegetation was killed by frost is shown in Fig. 3, curve 1. The head in the aquifer, however, is constant for the same period (Fig. 3, curve 2).

The sensitivity of these installations is shown in Fig. 4, which is a record taken during the period when an experimental drainage well in the gravel was pumped. The

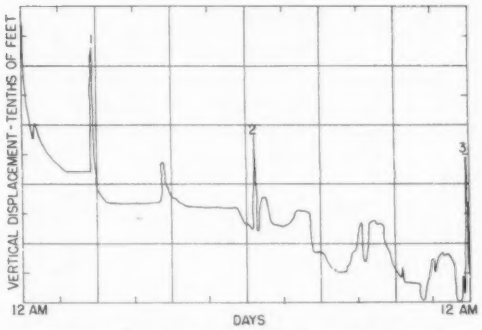

Fig. 4 Piezometer fluctuations during a pumping test indicating the sensitivity of the piezometer-recorder installations

three sharp peaks are due to periods during which the gas-driven pump was stopped to check the oil level.

Discussion

The effective separation of water-table and aquifer fluctuations is completely dependent upon the water seal that is obtained by driving the piezometer through the restraining layer.

The depth to which the piezometer can be driven will be the limiting depth of measurement. In most areas where upward artesian leakage leads to drainage difficulties, the head in the aquifer will be in the vicinity of the water table so that the depth of placement of the 6-in. pipe will seldom be greater than six feet.

Due to the finite volume of water required to cause a displacement in the float, the sensitivity of the installation is dependent upon the permeability of the material in which the end of the piezometer is located. The presence of sand in the piezometer will also lower the sensitivity. The recorder's sensitivity is dependent upon the cross-sectional area of the float. The float, therefore, should be as large as possible while still allowing for clearance in the 6-in. pipe. A one-pound coffee can makes a good sized float.

. . . Bulk Curing Tobacco

(Continued from page 515)

tions in the total mechanization of the harvesting and curing operations.

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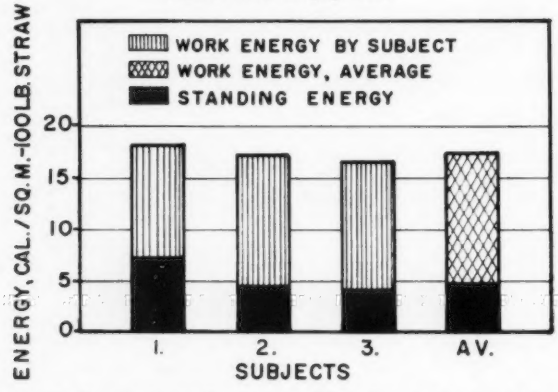

Fig. 10 Energy expenditure per 100 lb of material in shaking straw, based on body-surface area. (Average of ten tests for each subject)

tween energy expenditures on the two types of floors are significant at the 99 percent level for all activities. The greatest difference between means was for carrying 65-lb bales on the two types of floors. The energy values were 7.56 and 5.30 calories per square meter, respectively. By comparison, the difference between the means of the energy expenditures for dragging 65-lb bales on the two types of floors is much less, the corresponding values being 4.69 and 3.55 calories per square meter per minute. By contrast, the effects of walking surface are not as pronounced for carrying 45-lb bales, the energy values being 4.78 and 3.79 calories per square meter per minute for the straw and concrete floors, respectively. A straw floor gives very poor footing, and energy values increase markedly as the quality of the walking surface decreases.

Shaking and Distributing Straw

The energy data for shaking and distributing straw can logically be presented as either units of energy expended per unit weight of material or as energy expended per unit of time. Fig. 10 shows the energy expenditure data for this task in terms of amount of material handled, and Fig. 11 in terms of energy expended per unit of time. In each method of presentation, work energy is given as the total energy minus the energy required for standing. The standing energy used when the data were based on straw weight, rather than time, was the equivalent energy that would be required just for standing during the time that 100 lb of straw was being distributed.

The average total energy expenditure was 17.28 calories per square meter per 100 lb of straw, with a standard error of the mean equal 0.26. On a time basis, the average total was 3.33 calories per square meter per minute with the standard error of the mean of 0.05.

Differences Between Subjects

While the primary objective of this study was to determine specific energy values for different chore activities, and not to study differences between individuals, it is interesting to note the small differences between the three subjects when the data are presented on the basis of body surface area. Figs. 10 and 11 show that the differences between the three subjects for shaking and distributing straw were not great when presented on this basis. Subject 1 expended 12.83 calories per square meter per 100 lb of straw distributed; subject 2 expended 12.70 lb and subject 3 expended 12.53 lb. On the basis of energy expended per unit of time, subject 1 expended 2.31 calories per square meter per minute, subject 2 expended 2.48, and subject 3 expended 2.56. It should be re-emphasized that rigid control of rate of distributing straw was not exercised in these tests. The weight of straw distributed ranged from 86 to 98 lb per two bales of straw and the time for distributing the straw over the bedding area ranged from 4.06 to 5.57 min. Differences between individuals for other activities were generally no greater than for shaking straw.

Use of Data

The component energy determinations can be used as in the following example of finding the total energy cost of bedding down a 40-cow dairy heard. Assume that a loose housing barn is used as the loafing area and that baled straw, used for bedding, is stored overhead, 10 ft above the bedded area. Seven 45-lb bales of straw (350 lb) will be used each day, and in this example the following routine is assumed to occur during the bedding operation: (1) climb 10-ft ladder to hay mow; (2) walk on haymow floor to stack of straw, a distance of 25 ft, and return at end of operation; (3) pick up a bale of straw, carry it 20 ft and drop it to the bedded area; (4) return for another bale until seven are dropped down; (5) climb down ladder; (6) walk 25 ft on bedded area to where bales are dropped; (7) carry each bale an average of 12 ft on bedded area; (8) shake and distribute straw; (9) return on bedded area for other bales until seven are distributed, and (10) return to starting point. The component and total energies estimated for the operation are given in Table 1.

In the example given, slightly more than 73 percent of the total energy expended was for shaking and distributing the straw. The second highest expenditure was for carrying bales on the bedded area, but this portion was only 6.2 percent of the total. Other values, as shown, were quite small when considered in the total.

When considered in terms of energy expended per unit of time, also an important consideration, the carrying of bales is the most expensive operation of the total bedding

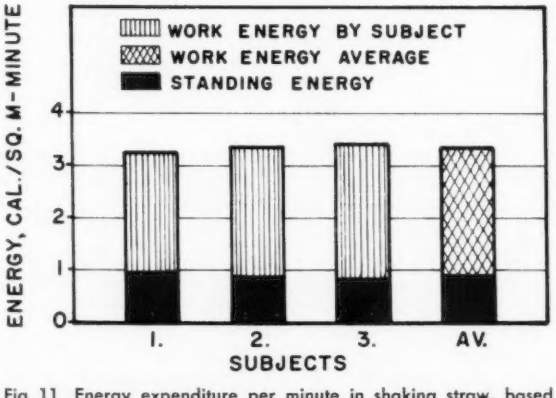

Fig. 11 Energy expenditure per minute in shaking straw, based on body-surface area. (Average of ten tests for each subject)

TABLE 1. ESTIMATED ENERGY USED IN BEDDING DOWN A DAIRY HERD

Operation*	Total distance traveled (ft)	Total energy expended (calories per square meter)
1**	10	2.10
2	50	1.04
3	140	3.58
4	140	2.91
5**	10	.76
6	25	.68
7	144	4.60
8	315 lb	54.50
9	144	3.36
10	25	.58
	Total	74.01

*Numbers correspond to previous operation descriptions.
**From Fox (1).

chore. As shown earlier, this energy could be reduced by dragging rather than carrying bales.

To conclude the example, assume that the man doing the work is 5 ft, 9 in. tall, weighs 165 lb, and has an estimated surface area of 1.9 sq m. Each of the energy values given in Table 1 can be multipled by 1.9 to give the total estimated energy expenditures for the various tasks. The sum total would then be 141 calories, or 436,000 ft-lb of energy used to bed down the herd of 40 dairy cows.

SUMMARY

As previously stated, the objective of the study reported in this paper was to determine the human-energy expenditures in bedding down livestock with baled straw. The chore task was divided into activity components of *(a)* lifting and stacking bales, *(b)* moving bales horizontally (carrying or dragging), and *(c)* shaking and distributing straw over a bedding area. Indirect calorimetry was used to measure the energy expended by three different test subjects performing the different activity components.

The variables in the study, exclusive of the three test subjects were bale weight (45 and 65 lb), rate of stacking bales (five and eight per minute), height of lifting bales (15, 30, and 45 in.), speed of horizontal movement (150 and 200 fpm), and type of walking surface (concrete and straw). Ten energy measurements were performed on each subject for each of the activity components, and the component data were projected to a typical dairy operation to show how the total energy for a particular physical plant can be estimated.

CONCLUSIONS

(a) Dragging bales is more efficient in human-energy expenditure cost than carrying bales, when the walking surface is poor and the bales are heavy. The energy expenditure is about 50 percent greater in carrying 65-lb bales than in dragging them on a concrete floor. In moving 65-lb bales horizontally on a straw floor, approximately 60 percent more energy is used in carrying than in dragging. Or, presented another way, about one-and-a-half times as much material can be moved for a given energy expenditure, by dragging as by carrying.

(b) A significant energy saving can be accomplished by walking on a firm surface. The saving by walking on the concrete instead of the straw floor is about 40 percent for carrying 65-lb bales and 27 percent for 45-lb bales. When bales are dragged, the energy saved due to a firm surface is approximately 32 percent for 65-lb bales and 29 percent for 45-lb bales.

(c) It is feasible to determine energy expenditures for many farm chore tasks by dividing the activities into components for replicate tests in the laboratory. After component energies are determined, the data along with time and distance information can be projected to different physical plants in over-all efficiency studies.

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. . . Lower Power Costs

(Continued from page 510)

(b) The gains exist in both large and small gasoline and diesel engines.

The value of operating an engine at reduced engine speeds for part loads might be questioned from the standpoint of wear rate, repair costs and governor performance. Brake mean effective pressures will increase as the engine speed is reduced with a constant horsepower output. This results in higher piston-ring pressures and bearing loads. However, total piston travel to accomplish a given amount of work and piston speed are reduced in direct proportion to the reduction in engine speed. Research is needed to determine if piston speed or brake mean effective pressure has the greater effect on wear rate.

Speed regulation of present engine governors is rather poor at reduced engine speeds. As a result, the field performance at reduced engine speeds would not be completely satisfactory. The governor should provide adequate speed regulation from rated engine speed down to approximately one-half of rated engine speed.

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Hosts ASAE Members at "Open House"

The New Idea Farm Equipment Co., Division of Avco Corp., entertained a group of ASAE members at its offices and plant in Coldwater, Ohio, June 16. It timed the "open house" to provide a travel break for members in public service en route from the ASAE Annual Meeting at Columbus, Ohio, to the ASEE Meeting at Purdue University the following week.

President C. W. Stoup of the New Idea Division was on hand, along with his agricultural engineering staff, to greet and entertain the guests. ASAE President L. W. Hurlbut was one of the visiting group.

According to R. C. Evans, product manager with New Idea, the event was a great success, attracting people from California to Maine and the Dakotas to Missouri. College guests totaled 91, including 22 children. Other guests totaled 65, including 27 women and children. Visitors had an opportunity to observe farm machinery engineering, manufacturing and testing facilities, including the use of high-speed movie equipment for machinery testing. The Coldwater plant is said to be the largest farm machinery manufacturing facility in the state of Ohio. The entertainment opened with a chicken barbecue. Special entertainment for the children included park equipment and free tickets for the swimming pool.

Nominations for 1961 ASAE Medal Awards

In accord with the rules governing the award of the John Deere and Cyrus Hall McCormick Gold Medals, the Jury of Awards of the American Society of Agricultural Engineers will receive from members of the Society, up to November 1, nomination of candidates for the 1961 awards of those two medals.

Members of the Society nominating candidates for either award are requested to keep in mind the purposes of each medal and make their nomination accordingly. The John Deere Medal is awarded for "distinguished achievement in the application of science and art to the soil," which citation is interpreted to cover more than a mechanistic concept of engineering, and to include chemistry, physics, biology, and any other science and art involving the soil, the "application" being acceptable to evaluation by the engineering criteria of practicality and economic advantage.

The Cyrus Hall McCormick Medal is awarded "for exceptional and meritorious engineering achievement in agriculture." Selections for the award may be in recognition of a single item of engineering achievement, but is more likely to be on the basis of the aggregate of weighted accomplishment through a continuing career.

The Jury of Awards desires that members of the Society consider it their duty and obligation to give serious thought to the matter and nominate for either or each of these awards the men they believe to be most worthy of the honor. Each nomination must be accompanied by a statement of the reasons for nominating a candidate and qualifications of the nominee, including his

(Continued on page 523)

ASAE MEETINGS CALENDAR

August 21-24—North Atlantic Section, University of Massachusetts, Amherst,

September 9—Washington, D.C. Section.

September 13-15—Farmstead Engineering Conference on Confinement Housing of Livestock, Lincoln Hall Theatre, University of Ilinois, Urbana, Illinois.

October 19-22 — Pacific Northwest Section, Empress Hotel, Victoria, B.C., Canada.

December 5-7—Winter Meeting, Peabody Hotel, Memphis, Tenn.

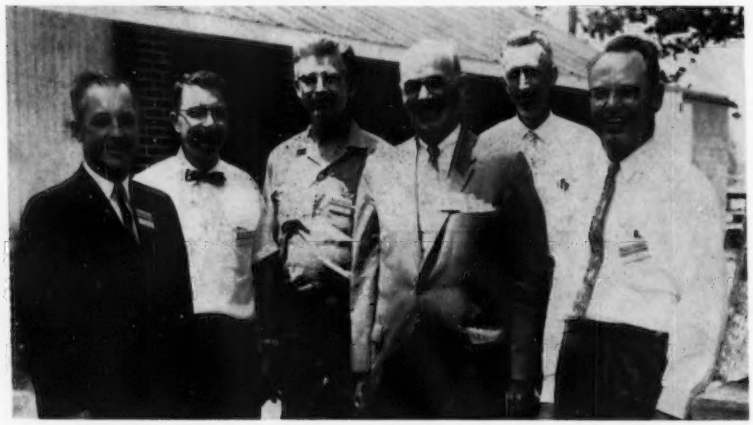
April 7-8 — Mid-Central Section, St. Joseph, Mo.

April 14-15 — Southwest Section, Grim Hotel, Texarkana, Texas.

June 25-28—Annual Meeting, Iowa State University, Ames, Ia.

Note: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

STAGES "OPEN HOUSE" FOR ASAE MEMBERS



C. W. Stoup, president of New Idea and vice-president of Avco Corp., and Blair Williams, vice-president and general manager of New Idea, were on hand to greet visitors during "open house" for ASAE members following ASAE Annual meeting. *(Left to right)* Williams; R. C. Evans, product manager who was in charge of arrangements for the visitors; O. C. French, head of agricultural engineering, Cornell University; Stoup; G. W. Giles, head of agricultural engineering, North Carolina State College; and L. W. Hurlbut, chairman of agricultural engineering dept., University of Nebraska, and newly-elected president of ASAE.

***(Left)* High-speed movie equipment used at New Idea's "torture test track" is demonstrated during plant "open house" tour *(left to right)* J. S. McKibben, University of Missouri; Karl Butler, Avco farm counselor; C. W. Stoup, president of New Idea and vice-president of Avco; Robert DeRegnaucourt, senior project engineer of New Idea; M. M. Jones, University of Missouri; V. C. Fuhrwerk, laboratory supervisor of New Idea; and O. C. French, Cornell University • *(Right)* Wallace McDougall, New Idea Field test supervisor *(2nd from right)* explains company's field test program to ASAE officers *(left to right)* R. P. Harbage, manager of engineering of New Idea; R. A. Palmer, assistant secretary and treasurer of ASAE; L. W. Hurlbut, president of ASAE; J. L. Butt, executive secretary of ASAE; McDougall; and R. C. Evans, product manager of New Idea.**

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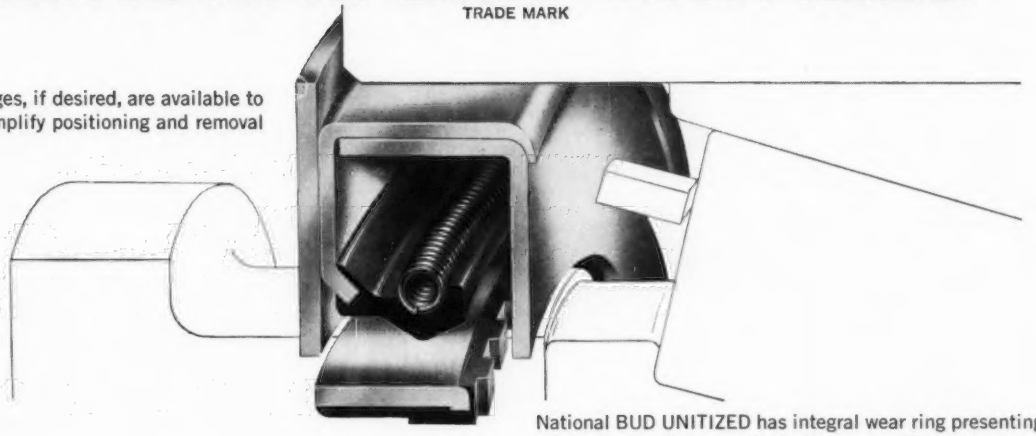

National BUD UNITIZED has integral wear ring presenting rubber surface to shaft. Wear ring turns with shaft, sealing lip is never exposed to damage, cannot score shaft.

A new unitized oil-seal-and-wear ring that eliminates:

SHAFT WEAR OR SCORING

SEPARATE METAL WEAR SLEEVES

EXPENSIVE SHAFT FINISHES

COSTLY SHAFT RE-MACHINING

SEALING LIP INSTALLATION DAMAGE

SPECIAL INSTALLATION PROCEDURES

New National BUD UNITIZED seals are now in production, in a limited range of sizes, for heavy oil and grease sealing applications — including truck, bus and tractor uses. Still newer BUD UNITIZED seals are on the way for higher speed automotive and similar uses.

Changing a National BUD UNITIZED oil seal automatically changes the wear sleeve — in one fast, simple operation. Since the seal has its own integral wear ring, it is almost impossible to install it other than squarely on the shaft. Expensive shaft finishing is no longer a necessity, nor is leakage under a metal wear ring a problem — both thanks to the rubber surface BUD UNITIZED presents to the shaft.

For complete details or skilled engineering help on application of BUD UNITIZED seals, write direct, or call your National Seal Applications Engineer. You'll find him in the Yellow Pages, under Oil Seals.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

6013-R

E. S. Rumely

R. R. Owen

L. E. Creasy

A revision in the product planning and marketing research activities of the Tractor and Implement Division, Ford Motor Company, which is said to keep abreast of the fast-moving technological changes in agriculture and industry, resulted in the promotion of three ASAE members as follows:

E. Scott Rumely has been named to the newly created position of operations planning manager. In this capacity he will conduct special long-range studies for the division's general manager. A graduate of Yale University, he joined the company in 1939 and since has served in a wide variety of management positions. These include shift superintendent for aircraft engine assembly and testing; industrial engineering and work standards development of the manufacturing staff; and transportation department assistant superintendent. Moving into product and program planning activities in 1949, he served at Ford Division until 1952 when he became manager of program planning for Tractor and Industrial Engine Division, and in 1953 he was named manager of the product planning and programming office of Tractor and Implement Division.

Robert R. Owen, who has been manager, implement product planning department in the product planning office, has been named to succeed E. S. Rumely as manager of the product planning and programming office. A graduate of the University of California, Mr. Owen joined the company in 1956. For six years previous he had been head of the agricultural engineering department of the Pineapple Research Institute at Honolulu, Hawaii, and earlier was a technical service representative of E. I. duPont de Nemours and Co.

Lawrence E. Creasy has been promoted to manager, implement product planning department. Mr. Creasy has been a member of the department since 1955. For three years previous he was with E. I. duPont de Nemours and Co., in agricultural engineering work, and earlier had been in the agricultural engineering department, Louisiana State University. He is a graduate in agricultural engineering from Virginia Polytechnic Institute, and received an M.S. degree in the same field from Louisiana State University.

Expansion of New Idea Farm Equipment Company's engineering efforts, was responsible for two key engineering management changes by ASAE members as follows:

R. R. Raney, director of engineering, has been named director of engineering and research. In his new position he will continue to have overall responsibility for the company's engineering program, and serve on the company's six man operating committee. In addition he will concentrate his efforts on new products and innovations, field contacts with agricultural leaders and evaluation of new inventions. Mr. Raney joined the company as director of engineering in 1955. Under his direction, the department has increased its manpower by nearly 30 percent and has developed an extensive machinery testing program.

Robert P. Harbage, who has been administrative assistant to the director of engineering has been promoted to the position of manager of engineering. In his new post he will be responsible for the day to day operation of the engineering department and coordination of its several sections on the maintenance of established programs. He joined the company in 1956 as a senior project engineer, later became a product engineer, and was named an engineering supervisor responsible for hay tool engineering programs in 1958. In June of 1959, he was promoted to serve as administrative assistant to the director of engineering.

R. R. Raney

R. P. Harbage

Carl R. Wilder, Portland Cement Association conservation engineer with headquarters in Denver since 1948, has been assigned to the association's western regional office in Los Angeles, Calif. In his new position, he will assist three PCA districts in Los Angeles, Seattle, and Phoenix in matters pertaining to flood control, irrigation, sewage works and water conservation and transmission.

John S. Perry has accepted an appointment as associate professor of agricultural engineering at the University of Massachusetts effective July 1. Since 1948 he has served on the staff of Pennsylvania State University, with Marketing Research Division of USDA and most recently as assistant professor of agricultural engineering at Michigan State University. He received a BS degree from Ohio State University in 1948, an MS degree from Pennsylvania State University in 1953, and a PhD degree from Michigan State University in 1959. His work at the University of Massachusetts will include teaching and research in the food engineering program.

C. R. Wilder

J. S. Perry

Thomas Wardrop, Jr. has been appointed as manager of the Chain Division of The Locke Steel Chain Co., at Huntington, Ind. During the past 20 years Mr. Wardrop has served in a number of capacities, most recently as sales manager for this division. In his new position, he will direct and coordinate all operations of the division and continue to supervise sales and customer relations.

Paul O. Berg, consulting engineer to the feed and grain industry, has been elected state secretary, Indiana Society of Professional Engineers.

M. Ray Parsons, who for several years was area engineer with the Soil Conservation Service, USDA, in Fresno, Calif., has accepted an assignment with the District Public Works Office, Twelfth Naval District, San Bruno, Calif. In his new position he will be special assistant for conservation and erosion.

Jesse L. Hicks, has recently accepted a position as state conservation engineer with the USDA Soil Conservation Service in Durham, N. H. From 1950 to 1959 he served as engineering specialist for the SCS with headquarters in Nashville, Tenn. For the past year he has been project engineer on the Lick Creek Watershed Project in Greeneville, Tenn.

Arnold C. Bishard has been appointed as agricultural engineer for the Clute Corp., Littleton, Colo., and will be in charge of the engineering and sales development programs for the company's grain cleaner, air conveying systems, and other air separation equipment for agricultural uses. Mr. Bishard is a graduate from Colorado State University, having received a B.S. degree in agricultural engineering this spring.

Nuredin N. Mohsenin joined the agricultural engineering staff of Pennsylvania State University January 1, 1960. His responsibilities include teaching courses in farm power for agricultural engineering majors, and research in fruit and vegetable processing. After receiving a B.S. degree in agricultural engineering from Oklahoma State University, he obtained M.S. and PhD. degrees in agricultural engineering at Michigan State University. He taught at the American University of Beirut in Lebanon, and at the University of Chiraz in Iran before returning to the United States and his present position.

C. P. Hedlin, formerly associate professor of agricultural engineering at the Ontario Agricultural College, is now associated with the Prairie Regional Station, division of building research.

A. C. Hardison, ASAE member since 1926, at the age of 91, attended a reunion marking the 70th anniversary of his graduation from the University of Maine. The year 1960 also marked his 70th year as a resident of Santa Paula, Calif., where he moved directly following his graduation. Of the original 36 students in his graduating class, five are still alive and three were able to attend the reunion. Of added interest, each of the three in attendance belonged to the same fraternity at the University of Maine.

. . . News

(Continued from page 520)

training, experience, contributions to the field of agriculture, a bibliography of his published writings, and any further information which might be useful to the Jury in its deliberations.

The Jury will accept and consider nominations received on or before November 1. These nominations should be addressed directly to the Executive Secretary of the Society at St. Joseph, Michigan. The Executive Secretary will supply on request a standard set of instructions for preparing information in support of nominees for the Society's gold medal awards. In fact, it is important that these instructions be followed in preparing material on behalf of any nominee.

Nominations for 1961 MBMA Award

ASAE members are invited to nominate qualified candidates for the MBMA Award for the year 1961.

This award made available by the Metal Building Manufacturers Association and accepted in 1958 by the ASAE Council for administration by the Society, was first awarded in June 1959. Its purpose is to recognize and honor young engineers "For distinguished work in advancing the knowledge and science of farm buildings."

Features of the award include (a) an engrossed diploma citing the achievement or service on which the award is based, (b) a presentation watch, and (c) to the school from which the recipient received his bachelor's degree, a plaque "in recognition of its contribution to the preparation of (the recipient) for outstanding achievement."

Any member of the Society in any grade may nominate a qualified candidate for consideration for the award. Additional members may support the nominating petition by signature.

To be eligible for consideration by the Jury, a nominee must be an ASAE member in good standing under 45 years of age at the time the nomination is received at ASAE headquarters. There are no other limitations to eligibility for consideration. Nominations for the 1961 award should reach ASAE headquarters on or before November 1, 1960.

Further instructions will be furnished by ASAE headquarters, on request, to any member interested in submitting a nomination. *(Continued on page 524)*

State Film Lending Libraries, Where ASAE Career Motion Picture "Agricultural Engineering — Profession with a Future" May Be Obtained

State	*Address of Film Library*
Alabama	Agr. Extension Service, Auburn University, Auburn
Alaska	Agr. Extension Service, University of Alaska, College
Arizona	Bureau of Audio-Visual Services, University of Arizona, Tucson 25
Arkansas	Audio-Visual Aids, Dept. of Public Relations, Arkansas State Teachers College, Conway Agr. Extension Service, P.O. Box 391, Little Rock
California	Extension Division, University of California, Berkeley 4
Colorado	Bureau of Audio-Visual Instruction, University of Colorado, Boulder Visual Aids Section, Colorado State University, Fort Collins
Connecticut	Audio-Visual Center, University of Connecticut, Storrs
Delaware	Dept. Rural Communications, University of Delaware, Newark
District of Columbia	D. C. Public Library, 8th and K, NW, Washington 4
Florida	Dept. Visual Instruction, General Extension Division, University of Florida, Gainesville
Georgia	Agricultural Extension Service, Athens Film Library, Georgia Center, University of Georgia, Athens
Hawaii	Agr. Extension Service, University of Hawaii, Honolulu 14
Idaho	Agr. Extension Service, 317½ North 8th Street, Boise
Illinois	Visual Aids Service, University of Illinois, Champaign
Indiana	Audio-Visual Center, Indiana University, Bloomington Audio-Visual Center, Purdue University, Lafayette
Iowa	Visual Instruction Service, Iowa State University, Ames
Kansas	Bureau of Visual Instruction, University Extension Division, University of Kansas, Lawrence Agr. Extension Service, Kansas State University, Manhattan
Kentucky	Dept. Audio-Visual Service, University of Kentucky, Lexington 29
Louisiana	Agr. Extension Service, Louisiana State University, Baton Rouge 3
Maine	Agr. Extension Service, University of Maine, Orono
Maryland	Agr. Extension Service, University of Maryland, College Park
Massachusetts	Audio-Visual Center, University of Massachusetts, Amherst
Michigan	Audio-Visual Education Center, University of Michigan, Ann Arbor Audio-Visual Center, Michigan State University, East Lansing
Minnesota	Agr. Extension Service, Institute of Agriculture, University of Minnesota, St. Paul 1
Mississippi	Audio-Visual Education, Dept. of Education, Jackson Agr. Extension Service, Mississippi State University, State College
Missouri	Audio-Visual Center, Southeast Missouri State College, Cape Giradeau Audio-Visual Dept., Dept. Continuing Education, University of Missouri, Columbia
Montana	Office of Information, Montana State College, Bozeman Montana State Film Library, Sam Mitchell Building, Helena
Nebraska	Bureau of Audio-Visual Instruction, University of Nebraska, Lincoln 8
Nevada	Agr. Extension Service, University of Nevada, Reno
New Hampshire	Audio-Visual Center, University of New Hampshire, Durham
New Jersey	New Jersey State Museum, State Dept. of Education, State House Annex, Trenton 25
New Mexico	Museum Film Service, Museum of New Mexico, Box 1727, Santa Fe Agr. Extension Service, New Mexico State University, Box 757, University Park
New York	Film Library, State Dept. of Commerce, 28 Howard Street, Albany 7 Dept. of Extension Teaching & Information, College of Agriculture, Cornell University, Ithaca
North Carolina	Bureau of Audio-Visual Education, University of North Carolina, Box 1050, Chapel Hill Agr. Extension Service, North Carolina State College, State College Station, Raleigh
North Dakota	Dept. of Information, Agr. Extension Service, North Dakota Agricultural College, Fargo
Ohio	Division of Audio-Visual Education, State Dept. of Education, State Office Building, Columbus 15 Agr. Extension Service, College of Agriculture, Ohio State University, Columbus 10
Oklahoma	Audio-Visual Education Dept., University of Oklahoma, Norman Agr. Extension Service, Oklahoma State University, Stillwater
Oregon	Dept. of Visual Instruction, Oregon State College, Corvallis
Pennsylvania	Audio-Visual Center, Chatham College, 1500 Woodland Road, Pittsburgh 32 Audio-Visual Aids Library, Pennsylvania State University, University Park
Puerto Rico	Agr. Extension Service, University of Puerto Rico, Box 607, Rio Piedras
Rhode Island	The Library, University of Rhode Island, Kingston
South Carolina	Agr. Extension Service, Clemson College, Clemson Audio-Visual Aids Bureau, University of South Carolina, Columbia
South Dakota	Agr. Extension Service, South Dakota State College, College Station
Tennessee	Film Service Division of University Extension, University of Tennessee, Box 8540, University Station, Knoxville 16
Texas	Visual Instruction Bureau, University of Texas, Austin 12 Agr. Extension Service, Texas A & M College, College Station
Utah	Audio-Visual Aids Library, Utah State University, Logan
Vermont	State Film Library, University of Vermont, Burlington
Virginia	Agr. Service, Virginia Polytechnic Institute, Blacksburg 12 Bureau of Teaching Materials, State Board of Education, Richmond 16
Washington	Office of Visual Education, Central Washington College of Education, Ellensburg Audio-Visual Center, Washington State University, Pullman
West Virginia	Audio-Visual Aids Dept., The Library, West Virginia University, Morgantown
Wisconsin	Bureau of Audio-Visual Instruction, University of Wisconsin, Madison 6
Wyoming	Audio-Visual Dept., University of Wyoming, Laramie

. . . News

(Continued from page 523)

Department Head Change at Arizona

Kenneth K. Barnes, chairman of the Power and Machinery Division of ASAE, recently has been appointed head of the agricultural engineering department at the University of Arizona, succeeding Harold C. Schwalen, who has been a member of the department since 1917 and its head since 1944. A Californian by birth, Mr. Barnes received all three of his professional degrees at Iowa State University, Ames. After serving three years in the Army during World War II, he was an instructor at Iowa State University for two years, an assistant professor at Purdue University for two years, and then returned to ISU to accept the position of professor of agricultural engineering, where he remained until he joined the University of Arizona staff last year.

Harold C. Schwalen, an ASAE member since 1928, leaves the University of Arizona, agricultural engineering department headship under a regents' ruling whereby administrators must step down from administrative posts at the age of 65. He will continue, however, as a member of the department he headed for 16 years. Born at St. Paul, Minn., he was a child when his parents came to Tucson, where he graduated from the high school. He earned a B.S. degree in mechanical engineering in 1917 and an M.S. degree in civil engineering in 1925 from the University of Arizona, and studied further at the University of Southern California, State University of Iowa, and the University of Wisconsin. During World War I, he served in the field artillery.

K. K. Barnes

H. C. Schwalen

BULLETIN

As the Journal goes to press word has been received that Keith Hinchcliff, professor of agricultural engineering, University of Illinois, his wife, and one daughter were fatally injured, and another daughter seriously injured in a train-car accident in Kansas, while vacationing. Further details will be carried in the September issue.

EVENTS CALENDAR

August 22-26 — 2nd annual *Western Resources Conference*, University of Colorado, Boulder. Contact Chairman M. E. Garnsey, professor of economics, University of Colorado, Boulder, for details.

August 28-31 — *Soil Conservation Society* 15th Annual Convention, Ontario Agricultural College, Guelph, Canada. For specific information write to: Soil Conservation Convention, Department of Soils, Ontario Agricultural College, Guelph, Canada.

ASAE Policy on Engineering Registration

DURING the Annual Meeting in June the Council of ASAE, adopted a policy endorsing and supporting the registration of professional engineers as being in the best interests of the engineering profession and the general public. To implement this policy, the ASAE:

1. Recommends that each ASAE section appoint a standing committee known as the Engineering Registration Committee to promote the registration of agricultural engineers, disseminate information concerning registration to the section members, and encourage student members to enter the Engineer-in-Training program.

2. Recommends that each ASAE section and student branch devote some time in one of their meetings each year to the subject of engineering registration where either a member of the State Engineering Registration Board or a prominent registered professional engineer would address them, placing special emphasis on the purpose of registration, the standards required for registration, the Engineer-in-Training program, and the procedure for applying for registration.

3. Recommends that ASAE sections cooperate with other engineering groups in sponsoring refresher courses on engineering subjects pertinent to the written examinations.

4. Approves in principle the NCSBEE (National Council of State Boards of Engineering Examiners) Model Law on Engineering Registration and pledges continued cooperation in its revision with other sponsoring organizations, with final form subject to approval by the Council of ASAE.

5. Offers support to assist in the appropriate revision or modification of registration acts in states where responsible organizations request such assistance.

6. Reaffirms that professional responsibility for engineering work is a personal responsibility. There should be no discrimination by implication, omission or direction as to the form of business organization (individuals, partnerships, corporation, or others) under which the practice of engineering is conducted, provided the person or persons executing or directing the work be legally registered professional engineers and affix the date and their seals to each document involving engineering judgment and discretion.

7. Supports financially the activities of the NCSBEE and gives advice and assistance to the NCSBEE Council when requested.

The Model Law for Professional Engineers

In August, 1960, the National Council of State Boards of Engineering Examiners will approve the final draft on the revised edition of a Model Law for Professional Engineers. This revision of the 1946 Model Law was a cooperative effort of all the engineering societies, including ASAE, through your Committee on Engineering Registration.

All fifty states have laws governing the registration of engineers and engineering practice. The Model Law is an attempt to obtain uniform legislation in all states governing the requirements of professional registration. The new Model Law has the endorsement of 13 engineering societies with national organization.

The pertinent changes in the 1960 Model Law are:

The elimination of the "grandfather clauses".*

The length of the examination required of the engineering graduate has been increased to 16 hours.

The non-graduate must offer 12 years of experience and pass a 16-hour examination.

There is now a provision which permits one board to recognize for credit the examinations given by another board. There is also a clause designed to give official recognition to the Certificate of Qualification issued by the National Bureau of Engineering Registration.

Section 22 of the Model Law covers the practice of engineering through corporate form of organization, it states "Professional Engineers may engage in the practice of engineering in this state for or associated with a firm, partnership, corporation, or joint stock association, provided each individual professional engineer assumes his full responsibility for all work under his direction, and provided he is legally registered in this state, etc." This section is in accord with published ASAE policy and that of several other engineering societies; however, this section of the Model Law has evoked more discussion than all the other 23 sections.

This revised Model Law in its final form is expected to be adopted at the next annual meeting of NCSBEE in Portland, Oregon in August, 1960. The Model Law will then be sent to ASAE and the other participating engineering organizations for adoption and endorsement.

*Clauses which permit anyone already established in a profession to continue, though he be unable to meet the new requirements.

For the New Graduate

In 36 or more states under present engineering registration laws, the newly graduated agricultural engineering student has an opportunity to take part of his state examinations immediately, while his college training is fresh. If passed, he will obtain an "Engineer-in-Training" certificate. Following his "Qualification Experience," he becomes a licensed professional engineer.

Far too many engineering graduates are leaving their college campuses without knowledge that a license is necessary to practice or that they have the opportunity to obtain the E.I.T. certificate. The ASAE Engineering Registration Committee highly recommends this method of obtaining your professional license and suggests that you contact your State Board of Engineering Registration for full information on E.I.T. and other pertinent engineering registration requirements.

Your State Board of Engineering Registration is generally located at your state capitol building. However, by writing the Secretary of the National Council of State Boards of Engineering Examiners, P.O. Drawer 1404, Columbia, S.C., you can obtain the full address of your state board.

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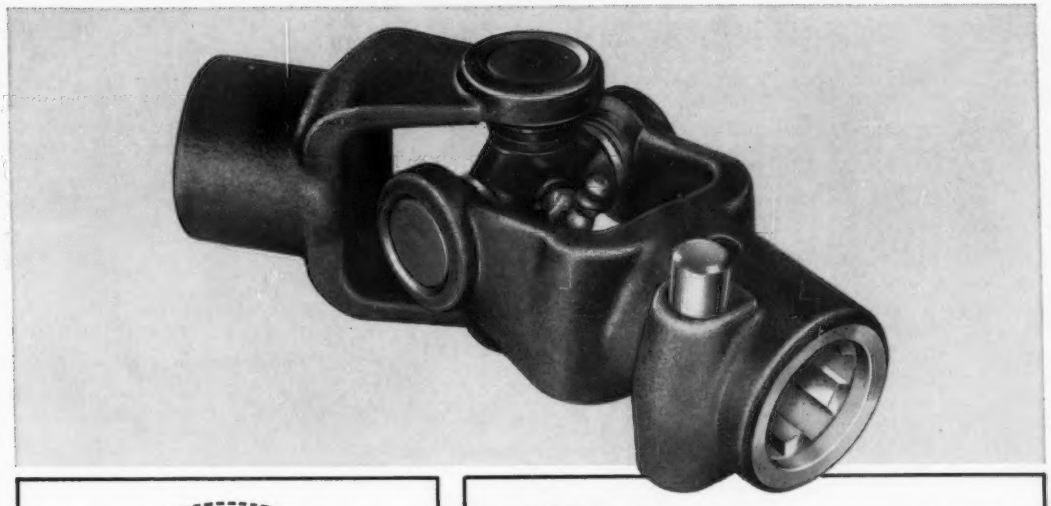

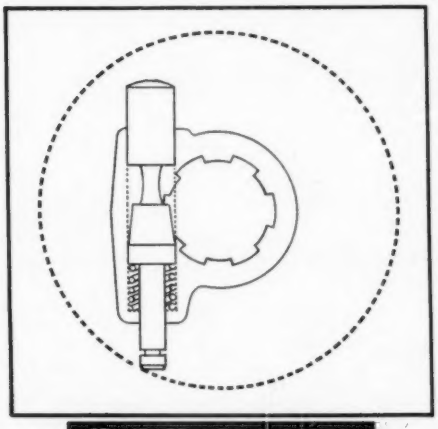

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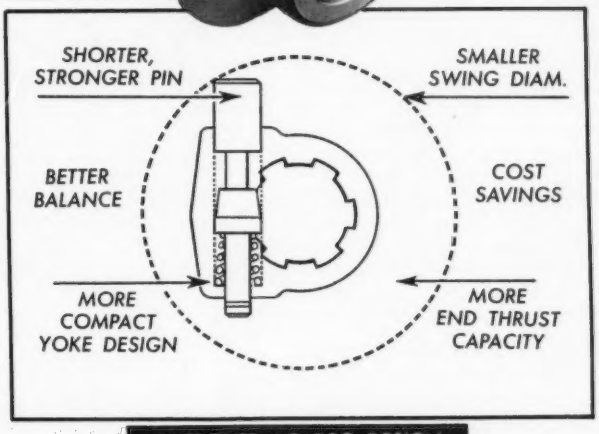

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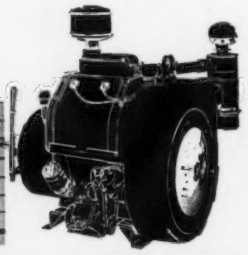

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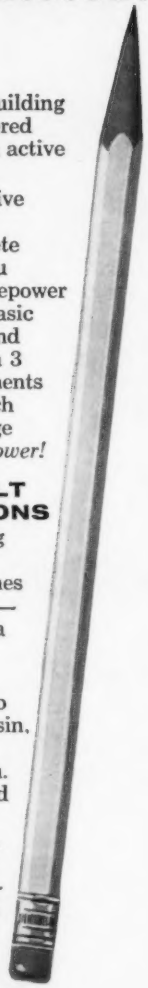

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FUEL SYSTEMS: you choose between gasoline, natural gas and LPG (for domestic application) and alcohol, kerosene, and No. 1 fuel oil (for export).

HYDRAULIC POWER: all Wisconsin V4's can be equipped with integrally-mounted hydraulic pump.

ELECTRICAL EQUIPMENT: you can select 6 or 12-volt starter-generator systems for all models, 3 through 56 hp. Solenoid switches and automatic choke, for remote or automatic starting, are also available.

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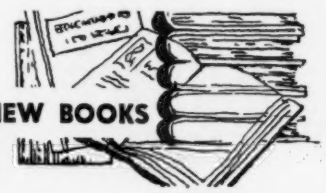
Write for your copy of Wisconsin Bulletin S-249 with data covering complete Wisconsin line. Address Dept. O-40.



1958-59 Annual Report of the National Institute of Agricultural Engineering. Paper. 7¼ x 9½ in. 186 pages. Illustrated. Available from the National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire, England.

This report covers the period October 1, 1958 to September 30, 1959, and includes the following departmental reports: Administration; agricultural testing; field investigation; glasshouse research; horticultural engineering; instrumentation; mechanical engineering; soil; survey; and Scottish. A supplement is also included which covers NIAE test reports and summaries of papers by its staff published in the *Journal of Agricultural Engineering Research.*

The Engineering Index—1959. Cloth. 7 x 10 in. 1532 pages. Published by the Engineering Index, Inc., 29 W. 39th St., New York 18, N. Y. Price, $70.00 — postpaid.

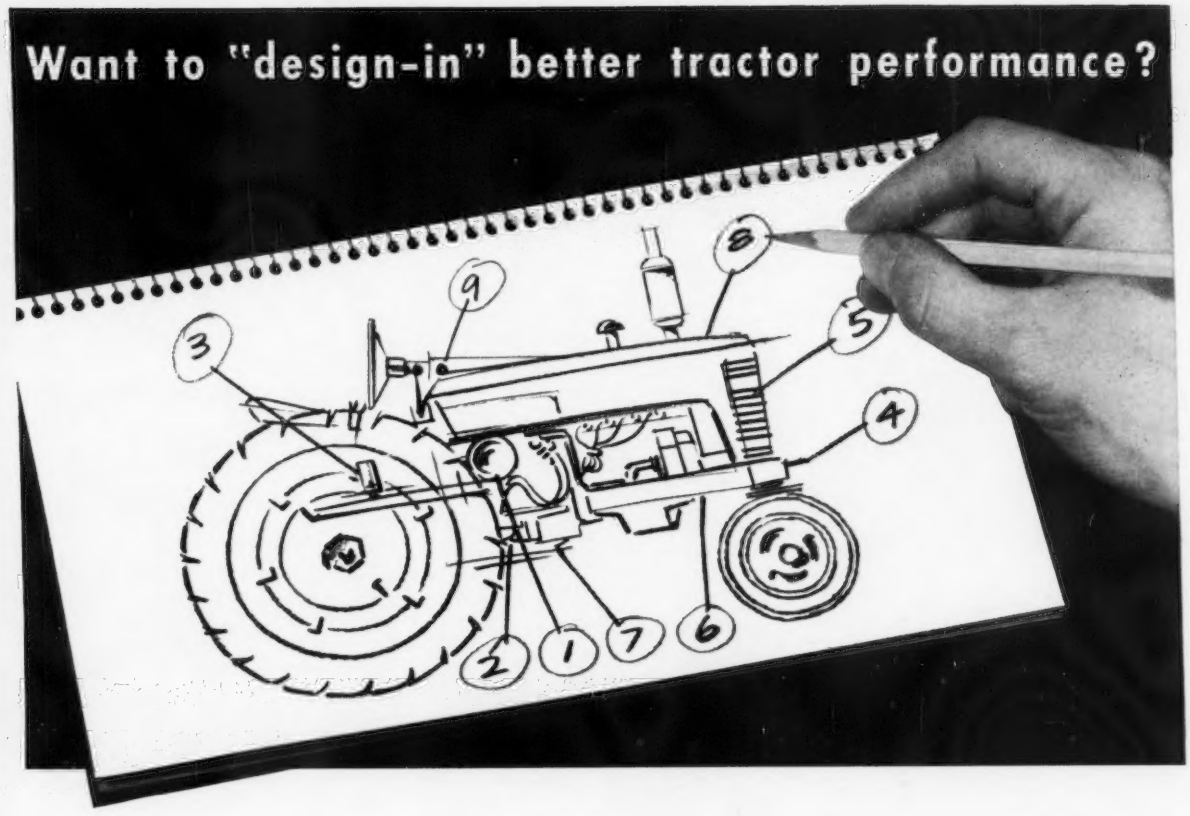
This 75th edition of the Index contains over 39,100 annotations of articles reviewed in some 1,700 publications of engineering, scientific, and technical societies; engineering and industrial periodicals, and publications of government bureaus; engineering experiment stations, universities, and other research organizations. Selection of articles appearing in these publications is made on the basis of how they deal with the art and science of engineering. It is arranged under 240 "field of interest" divisions of engineering. It also contains a list of technical publications received by the Engineering Societies library and reviewed by EI, as well as an index of the authors of articles reviewed.

Proceedings of the 1959 Institute in Technical and Industrial Communications. Edited by Herman W. Weisman and Roy C. Nelson. Available from the Institute in Technical and Industrial Communications, Colorado State University, Fort Collins. Price, $5.00.

This is a reference work or text in technical writing, editing, and journalism, covering practices and theories of scientific and technical communications. The 17 papers making up this volume were presented at the sessions of the 1959 Institute. Contained in this book are the best experiences of this country's and Canada's finest practitioners in scientific, technical, and industrial communications.

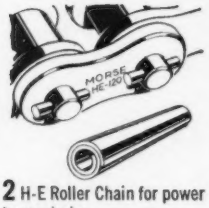
1960 European Technical and Commercial Trade Fairs. Paper. 8¼ x 12½ in. 12 pages. Published by European Technical Coverage, Inc., 75 E. Wacker Dr., Chicago 1, Ill.

The guide, designed for the manufacturer, marketing expert, engineer, and scientist who wants to keep current with new products and processes developed abroad, lists more than 500 major European technical and commercial trade fairs scheduled in 1960. It is arranged by subject, date, and geographical location, and covers shows in 25 countries and 41 market classifications, including automotive, agriculture, clothing, electronics, furniture, laboratory, and measuring instruments, machine tools, shoes, textiles, etc. *(Continued on page 529)*

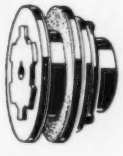


First—check these Morse power transmission components to solve many design problems!

1 Taper-lock sprockets on side power-take-off shaft

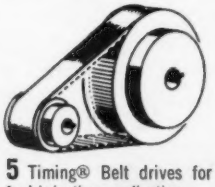


2 H-E Roller Chain for power transmission

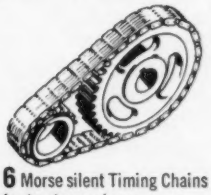


3 Morse torque limiter on power-take-off shaft

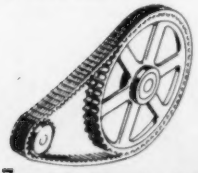
4 Morflex coupling on front-end drive shaft take-off



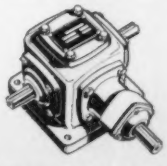
5 Timing® Belt drives for fuel injection application



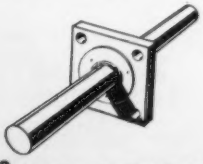
6 Morse silent Timing Chains for tractor engines



7 Hy-Vo® Drives for drop-box transmission



8 Miter boxes for pto drives for saws or grinding wheels



9 Two-Way, No-Way Clutch for hand throttles

Morse power transmission components have wide proved-in-the-field application superiority. By designing them into your tractor or farm machinery, you can simplify and cut many hours off design problems . . . even lower production costs.

Examine these examples of Morse "exclusives". Then call in a Morse engineer to work with you from the start. His broad experience can be a valuable shortcut to a better product for you. Call or write: Morse Chain Company, Dept. 38-80, A Borg-Warner Industry, Ithaca, N. Y. Export Sales: Borg-Warner International, Chicago 3, Ill. In Canada: Morse Chain of Canada, Ltd., Simcoe, Ontario.

MORSE B-W T.M.

A BORG-WARNER INDUSTRY

Pneumatic Grain Cleaner

Clute Corporation, Rocky Ford, Colorado, has introduced a new pneumatic grain cleaner. The new grain cleaner is a pneu-

matic system which operates by a combination of gravity and cyclonic air flow in a basic cleaning tube or "leg". A fan powered by electric or other motor is built into the top of the equipment and draws clean air in a spiral motion up through the leg. Grain or seed is fed by gravity into the receiving hopper below the fan and falls with centrifugal action through the air stream, where it is cleaned and conditioned, and into the conveyor hopper ready for storage.

Dust, chaff, broken kernels, weed seeds, and other foreign material lighter than the grain are drawn upward by the air stream and discharged into a collector without passing through the fan. By the installation of several cleaning legs, foreign materials of different weights, such as dust and chaff and cracked kernels, may be carried off into separate collectors in one cleaning operation. Damper controls on air intake in the cleaning leg govern the degree of separation and may be adjusted by the operator to effect the cleaning action desired. For example, dust and weed seed may be drawn from grain intended for feed without removing the coarse cracked kernels. No other changes of parts or equipment are necessary for the handling of different grains to be cleaned. Stationary and trailer mounted units are available.

Semi-Pneumatic Tires Effect Savings

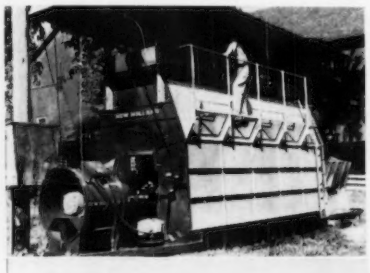
The Ohio Rubber Co., Willoughby, Ohio, has reported that research and development in semi-pneumtic tires designed specifically

for use on gage wheels and press wheels for planters, drills, plows, listers, cultivators, balers and cutters have resulted in many advantages for the farmer. The company reports that use of these tires can speed up and improve germination, produce better stands, boost yields, help maintain timetables and reduce labor output. The company reports that by combining rubber's natural flexing quality with special tire design, semi-pneumatic tires are able to throw-off excessive build-up of moist soil which otherwise seriously affects the proper working depth of equipment. This feature, it is pointed out, makes it possible to save valuable working days during the growing season because fields can be worked sooner to prepare seedbeds, plant and cultivate after rains.

Company studies reveal that properly designed semi-pneumatic press wheel and seed press tires utilize existing moisture conditions to insure good germination and high emergence. By gently pressing seed into the moist soil and by pressing the soil around seed to conserve moisture, these tires assure the most favorable planting conditions in any number of soil types and conditions. In dry soils the compaction effect of these tires minimizes air pockets and, by improving the capillary action of the moisture in the soil, speed germination.

New Driers Added

New Holland Machine Co., Div. of Sperry Rand Corp., New Holland, Pa., has announced three new crop drier models.



Two models, 735 and 765 and designed for alternately heating and cooling grain, are represented in the top illustration.

In these models, all the grain is constantly circulated. The grain moves down 24-in. wide heating columns. Then it goes up the roller chain elevator to the "holding" area for cooling, and back into the heating column. This cycle is repeated until moisture content has been reduced to the desired level. There are eight circulation rates on the Model 735, which handles 350 bu. The larger Model 765 with 585-bu. capacity, has six rates. Both models are designed for either electric or tractor drive and are available in portable models.

The third model 750 (shown in bottom illustration) is operated by selecting the amount of heat best suited for the crop and by setting a fuel dial accordingly. The rest is automatic. A convenient control panel with indicator lights shows how the unit is operating. This model is available in portable or stationary models and can be used for baled or chopped hay, grain or ear corn.

Speed Monitor

Knecht's Inc., 3400 Main St., Springfield, Ore, has introduced a new hydraulic coup-

ling designed to convert any variable speed rotating energy source to constant speed without loss of power. Called the speed monitor, the new device is a precision engineered all-fluid coupling cast in aluminum. Its internal working parts consist of heavy-duty ball bearings, hydraulic chambers, and sealed-in fluid. Centrifugal force reportedly regulates output speed to a constant rate regardless of input speed. The manufacturer foresees many applications in the field of mobile and remote electrical power supplies. The unit is said to convert any variable speed power source to a regulated constant speed power supply for direct coupling to 60 cycle a-c generators or alternators.

Straw Choppers for Small Combines

Innes Co., Bettendorf, Iowa, has announced two new models of their straw chopper designed for attaching to IH 80

and 91 combines. Both models provide full 20-in. swing. Spirally curved hammers are arranged to give smooth action with low power drag on the engine and maximum force for ejecting chopped straw with what is described as hurricane action.

Adds to Insulating Glass Line

Libbey-Owens-Ford Glass Co., 811 Madison Ave., Toledo 3, Ohio, has developed a new lightweight all-glass insulating glass, designed to fit many types of double-hung, casement and awning windows. The new product is now being made in 36 standard sizes in widths from 20 to 40 7/16 in. and in heights from 16 to 24 7/16 in. It is made with two panes of single strength window glass with a nominal air space thickness of 3/16 in. between the panes. Dehydrated, clean air is enclosed.

British Engine Runs on Jet Fuel

Rootes Motors, Inc., 42-32 21st St., Long Island City, New York, has announced that a new engine which reportedly runs on high or low test gasoline, diesel oil, kerosene, jet fuels or even cleaning fluid is being introduced to the United States. The engine is suitable for use in cars, trucks, busses, tractors, farm machinery, boats, and many industrial applications such as electric power generation. Main significance of the new engine is that it will allow utilization of the most economical kind of fuel available in any given area. The multi-fuel feature depends on a special type of variable pressure fuel injection system which varies the amount of fuel fed into the combustion chambers depending on the fuel being used.

The basic engine, a 2-cycle, 2-cylinder unit, is designed to deliver 105 bhp. Variations in design allow 75 and 85 hp ratings as well.

Farm Applications for Blimp-Like Tire

Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio, has reported that development of its stout, cylindrical tire,

called Terra-Tire, has opened new opportunities for vehicle manufacturers.

In the five-year period since its development some unusual vehicles, ranging from missile-carriers to marsh buggies, have been designed. Included in the list of Terra-Tire-equipped vehicles are farm tractors, scrapers, graders, golf carts, mining equipment carriers, logging tractors and many others. Farm applications reported include harvesting rice in fields, hauling bananas over irregular terrain without bruising the fruit, on trailers to haul large loads of sugar cane out of soft fields, moving heavy spray-type fertilizing equipment over soft ground, and harvesting cranberries, taking out the ripe berries and after-harvest sanding in watery bogs. Terra-Tires are constructed of nylon and are available in a wide range of sizes and tread patterns, depending upon the job they must do.

. . . New Books

(Continued from page 526)

Applied Solar Energy Research — Second Edition. Cloth. 8¼ x 11 in. xxi+275 pages. Available from the Association for Applied Solar Energy, 3424 N. Central Ave., Phoenix, Ariz. Price, $7.50, plus 20 cents postage if payment does not accompany order.

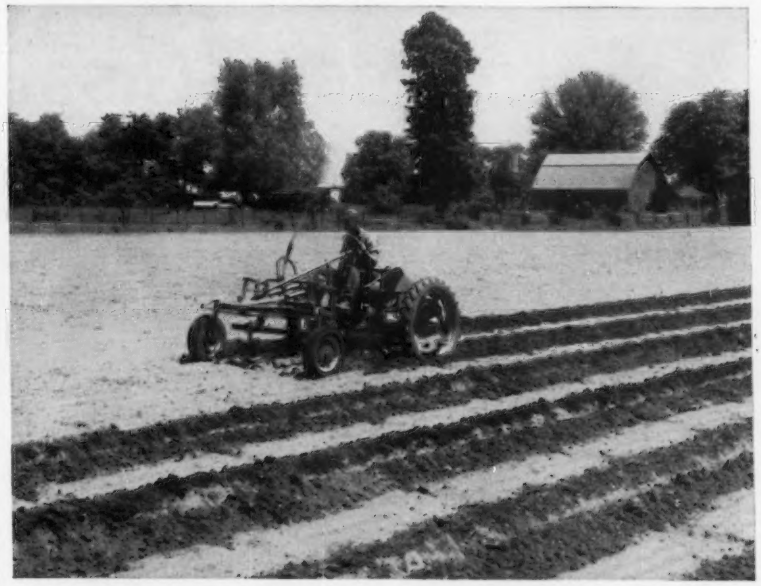
This edition is a directory of world activities and bibliography of significant literature. The book is divided into two parts — Part 1 is a directory of world research activities and Part 2 is a bibliography on solar energy utilization with the following breakdown: Sources of energy — the fuel situation; solar energy — general papers; solar radiation; solar radiation effects; the use of solar energy as heat; and the use of solar energy as light. Also included is an author index.

Zur Wiederurbarmachung im Braunkohlenbergbau (On the Reclamation of Brown Coal Stripmined Lands), by Wilhelm Knabe. 150 pages. Published by Veb Deutscher Verlag Der Wissenschaften, Berlin W. 8, Niederwallstrasse 39, Germany. Price, E.D.M. 36.60.

This book covers all the problems involved in stripmining of coal, which affect industry, scenery, human, animal and plant life, created soil, barren toxic areas, topography, water economy, water and air polution, climate and traffic, etc. It also records the results of a study on stripmined land conducted during the last 8 years in Eastern Germany. The author divides the study into two parts: The first part is a comprehensive report and analysis of all the details of the general problems of stripmining, its consequences and reclamation; the second part reports the actual procedures developed and performed by the author to demonstrate the successful application of the conclusions of his analysis.

1960 Year Book of The Tire and Rim Association, Inc. 8¾ x 11 in. Paper (spiral bound). Available from The Tire and Rim Association, Inc., 2001 First National Tower, Akron 8, Ohio. Price, $3.50.

This 1960 edition of the TRA Year Book contains the following tabbed sections: Section 1, Passenger Car; Section 2, Truck-Bus; Section 3, Off-the-Road; Section 4, Agricultural; Section 5, Industrial; Section 6, Valve; and Section 7, Aircraft.



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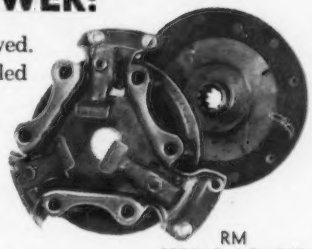
MEANS GROWING POWER!

Growing power means time and money saved. Rockford Clutches are the perfect controlled power-link between engine and work. These small spring loaded clutches are used on many small tractors, cars, and industrial trucks. Next time specify Rockford. Many types and sizes of clutches and power take-offs are available. Write today for complete details.



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MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Underground Sprinkler Systems

Rain Jet Corp., 301 S. Flower St., Burbank, Calif. — Offers the following two literature pieces:

"How to Plan, Layout and Install a Rain Jet Underground Sprinkler System" is a 2-color brochure that shows in 10 easy steps exactly how the homeowner can install a complete underground sprinkler system in as little as 3½ hours. A scaled graph sheet is included together with templates showing the coverage of all underground sprinkler heads at various pressures. Also shown are installations for various sizes and shapes of yards.

"Keeping American Lawns Beautiful" is a 24-page, 2-color catalog giving complete operating data, specifications and suggestions for using the different underground sprinkler heads. The various patterns and sizes are described, including squares, rectangles, full, half and quarter circles. Coverage, discharge, and pressure tables are included, and number of heads operative per valve at full performance for various pipe sizes is listed. It also enumerates all accessories including many new products.

Agricultural Systems for Airplanes and Helicopters

Agricultural Aviation Engineering Co., Inc., 858 Scott St., Santa Clara, Calif. — Three circulars on agricultural systems for airplanes and helicopters include: One on helicopter spray equipment; one on aluminum control valves; and one on aircraft spray control valves.

Filtration Products Booklet

Purolator Products, Inc., Dept. 135, Rahway, N. J. — An 18-page "Filtration Products" booklet, No. IND-1-60, lists and details information on various filter media for process fluids, nuclear applications, internal combustion engines, hydraulic fluids, machine tool coolants, bulk fuel, and many other applications, plus operating specifications for range of filtration, temperature limits, flow characteristics, and typical applications and assemblies are used to illustrate ranges.

Surface Moisture and Density Probes

Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill. — A 2-page, 2-color bulletin gives complete specifications for the surface moisture and surface density probes and photos show their correct use for both moisture and density tests in conjunction with soil compaction work.

Precision Instrument Bearings

Miniature Precision Bearings, Inc., Keene, N. H. — A 4-page, 2-color bulletin, No. 6002, describes high precision thin-width instrument bearings, designed for use in synchros, gear trains, potentiometers, servos and small motors. Specifications are also included.

Reusable Inflatable Void Forms

Elgood Concrete Services Corp., 378 Ten Eyck St., Brooklyn, N. Y. — A 12-page catalog, No. 602, describes and illustrates its reusable inflatable void forms for: Prestressed and precast products; cast in place; drains; monolithic sewers; and monolithic pressure pipe. Specifications are also listed.

Thermocouples Bulletin

The Marlin Manufacturing Corp., 12404 Triskett Rd., Cleveland 11, Ohio — Designated as Catalog No. 602, this 4-page, 2-color piece gives descriptions, illustrations, and specifications for metal sheathed, inert oxide insulated thermocouples in assemblies and random lengths for laboratories, chemical process systems, industrial furnaces nuclear reactors, aircraft engines, missiles, and steam generators.

Industrial Plastics Booklet

The Polymer Corp. of Pennsylvania, 2140 Fairmont Ave., Reading, Pa. — A 12-page booklet, No. BR-1, entitled "Industrial Plastics" contains property and application data on available mill shapes of nylons, fluorocarbons, polycarbonates, chlorinated polyethers, and cross-linked polystyrene. Data on nylon pressure hose and tubing is also presented.

Better Welds Vest Pocket Guide

Hobart Brothers Co., Box EW-213, Troy, Ohio — "Vest Pocket Guide to Better Welds" is a revised edition of "How to Get Better Welds" and contains 80 pages of arc welding information. It is divided into four sections: Proper procedures; metal identification; common faults; and selecting electrodes.

Joist and Beam Hangers

Timber Engineering Co., 1319 18th St., N.W., Washington 6, D. C. — A 4-page booklet presents design and use information on joist and beam hangers, and also provides recommended safe working values. It also illustrates applications where the hangers can be used for economical wood frame construction, and includes a simple formula for determining maximum joist spans for the various type grips.

MOLDED FIBER GLASS

Agricultural Tank

Ideal for many farm uses, this 200-gallon tank is tops for use as a spray tank, portable water tank or storage tank.

It fits standard spray units, is unaffected by many chemicals including most insecticides and liquid fertilizers, and will outlast metal tanks many times over. It costs considerably less than stainless steel.

Lightweight, exceptionally strong, easy to handle, easy to clean, this tough, translucent MOLDED FIBER GLASS tank withstands very hard usage.

Specifications: 200-gallon capacity; 58¾" length; 32" diameter; 55 pounds. (Special sizes and shapes molded to your specifications.)

Available for immediate delivery, assembled or knocked-down. Special quantity discounts. *Write today for detailed information.*

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GREATEST NAME MOLDED FIBER GLASS IN REINFORCED PLASTICS

One of the affiliated Molded Fiber Glass Companies, world's largest producers of fiber glass reinforced plastic.

Tailored Torque Brochure

Warner Electric Brake & Clutch Co., P-78, Beloit, Wis. — A 4-color brochure entitled "Tailored Torque" explains operating principle, describes several clutch, brake, and clutch-brake applications, outlines specific operating advantages, and includes torque rating and package dimensions for complete product line.

Tailor-Made Power Steering Systems

Vickers, Inc., Division of Sperry Rand Corp., Mobile Hydraulics Div., Administrative and Engineering Center, Dept. 1400, Detroit 32, Mich. — Bulletin No. M5110, a 17-page, 3-color brochure, describes and illustrates complete line of production-built power steering components. Included are component selection tables, performance curves, and typical examples for determining the proper size steering components to meet various turning speed and steered axle load requirements.

Reusable Hydraulic Hose, Couplings and Fittings Literature

Anchor Coupling Co., Inc., 342 N. Fourth St., Libertyville, Ill. — A 21 x 32 in., 2-color wall chart (showing dimensions of reusable hydraulic hose, couplings and fittings, plus catalog numbers) and a 10-page leaflet (giving highlights of complete hydraulic hose, couplings and fittings for replacement use) tie in with the 24-page catalog, No. D-1, entitled "Reusable Hydraulic Hose, Couplings and Fittings." This catalog gives step-by-step photographic instructions for assembling various type couplings to hose, detailed product data, and specifications.

Tube Fittings Catalog

The Imperial Brass Manufacturing Co., 6300 W. Howard St., Chicago 48, Ill. — Catalog No. 3108, a 48-page punched piece, describes and illustrates complete butt-joint fitting line. Included are sections on pressure, vacuum, temperature, vibration, corrosion resistance, port seals, flow and velocity characteristics, along with laboratory reports and complete assembly instructions. Styles, sizes and materials are also listed with complete dimensional data on each type.

Machining Ductile Irons Booklet

The International Nickel Co., Inc., Ductile Iron Div., 67 Wall St., New York 5, N. Y. — An 18-page booklet entitled "Machining Ductile Irons" is a revised and augmented edition presenting a thorough review of the various machining and grinding techniques recommended for all grades of ductile iron. Typical microstructures are illustrated and descriptive sections cover such subjects as recommended tool material, tool geometry, cutting speeds, lubricants, grinding wheels, and ground surface finishes. Also described are the following machining operations: Turning; milling; drilling; broaching; gear hobbing and shaping; grinding; honing; lapping; and superfinishing. Requests should be made on company letterhead.

Mechanized Feeding Systems Booklet

A. O. Smith Corp., Harvestore Products, Kankakee, Ill. — Bulletin No. MH-112, a 36-page, 2-color booklet entitled "Planning for Profit With Harvestore Mechanized Feeding Systems," was prepared to show how both storing and feeding can be mechanized to provide a complete material handling system and it covers the fundamental requirements of a feedlot system. It also contains 12 actual farm feedlot plans and each farm represents an individual problem with varying requirements and needs. Price, $1.50.

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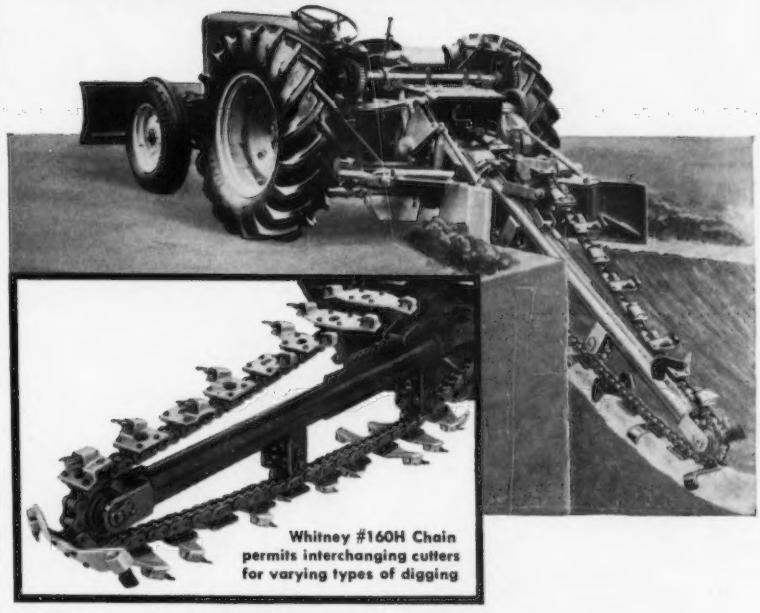
RUGGED, LONG-LIFE CHAIN

—WHITNEY was the Choice!



Whitney #160H Chain permits interchanging cutters for varying types of digging

Heavy Duty "TRENCH HOG"

Delivers Maximum Performance

When ARPS CORPORATION engineers were designing the "Trench Hog" trencher, they knew that extreme demands would be put on the drive chain and especially the digging chain which carried the cutters. Users don't baby equipment like this, and they expect it to stand up under long, hard service—no matter how tough the digging.

Arps engineers selected Whitney #160H Chain for the digging chain and standard Whitney Chain in 3 sizes for drive chain. After more than 10 years of experience with thousands of units in the field, here's the record: **Arps has never received a complaint on the "Trench Hogs" chain performance.**

Whitney Chain is superior performance chain because every detail of Whitney Chain production involves careful quality control and the use of the most advanced chain manufacturing techniques. More is put into every Whitney Chain to insure that the user gets more out of it.

Whitney Chain is sold and serviced by a network of strategically located Distributors who can provide expert help in solving any chain drive problem. Ask them, or write for the Whitney Chain Catalog.

THE WHITNEY CHAIN COMPANY

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4579 S. Western Blvd., Chicago 9, Illinois

POWER TRANSMISSION DRIVES

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Arango, Ivan G. — Central Aguirre Sugar Co. (Mail) P.O. Box 402, Aguirre, Puerto Rico

Brzustowski, Jerzy M. — Sr. res. engr., Massey-Ferguson Co., Ltd., 915 King St., W., Toronto 3, Ont., Canada

Burns, Loren V. — Vice-pres. and tech. dir., Mel Miller and Co., Inc., 20 W. Ninth Street Bldg., Kansas City 5, Mo.

Dvoracek, Marvin J. — Jr. spec.-lecturer, agr. eng. dept., University of California. (Mail) Box 599, Davis, Calif.

Feenstra, James E. — Sales rep., Haviland Agricultural Chemical Co. (Mail) 4122 Taft, Kalamazoo, Mich.

Hamachek, Frank III — Pres. and gen. mgr., Frank Hamachek Machine Co. (Mail) 205 Rose St., Kewaunee, Wis.

Harvey, Gerald J. — Product engr., John Deere Welland Wks. (Mail) 65 Fraser St., Welland, Ont., Canada

Johnson, Wallace G. — Marketing spec., markets div., cotton and eng. section, North Carolina Dept. of Agr., Box 2281, Raleigh, N. C.

Kirschbaum, William T. — Jr. engr., Pineapple Research Institute of Hawaii, P.O. Box 3166, Honolulu 2, Hawaii

Maple, Larry R. — Production engr., eng. dept., Mel Miller & Co., Inc., 20 W. Ninth St., Kansas City 5, Mo.

Overcash, Arbon W. — Eng. asst., Virginia Electric and Power Co. (Mail) R.R. 3, Salisbury, N. C.

Pellen, Joe — Chief des. engr., New Holland (Australasia) Pty., Ltd. (Mail) 50 Hughes Cresct, Dandenong, Australia

Priester, Peter F. — Sales mgr., John Deere Plow Wks., 1225 Third Ave., Moline, Ill.

Singer, Robert B. — Chief engr., eng. and res. div., Minneapolis-Moline Co., Hopkins, Minn.

Snowden, Obed L. — Head, agr. educ. dept., Mississippi State Univ., Box 1419, State College, Miss.

Spence, James T. III — R.R. 1, Pink Hill, N. C.

Van Niekerk, Jan S. — Managing dir., Van's Construction, 63 Zastron St., Bloemfontein, South Africa

Walton, David G. — Jr. engr., New Idea Div., Avco Corp. (Mail) 300 N. Elm St., Coldwater, Ohio

Wheelock, Horacio A., Jr. — Chief engr., irrigation proj., Instituto DeFomento Nacional. (Mail) 4 Calle, N.E. #310, Managua, Nicaragua

Willworth, John H. — Proj. engr., Interurban Industries, Inc. (Mail) 5218 Kevohenal Dr., Lawrence, Ind.

Wissing, Owen J. — Gen. mgr., Kengas, Inc., 608 Frederica, Owensboro, Ky.

TRANSFER OF MEMBERSHIP

Coppock, Glenn E. — Assoc. agr. engr., Florida Citrus Commission, Citrus Experiment Station, Lake Alfred, Fla. (Associate Member to Member)

Curry, R. Bruce — Asst. prof., agr. eng. dept., Ohio Agr. Experiment Station, Wooster, Ohio (Associate Member to Member)

Hart, William E. — In charge of irrigation eng. res., field eng. dept., experiment station, Hawaiian Sugar Planter's Assn. (Mail) 2510 Bancroft Way, Berkeley 4, Calif. (Associate Member to Member)

Payne, Donald W. — Farm rep., Auburn dist., New York State Electric and Gas Corp., 26 North St., Auburn, N. Y. (Affiliate to Member)

STUDENT MEMBERSHIP TRANSFERS

Anderegg, Robert B. — (Iowa State University) John Deere Dubuque Tractor Works, Dubuque, Iowa

Andersen, William K. — (University of Idaho) 1037 Blue Lake, N., Twin Falls, Ida.

Bauerle, Russel H. — (Michigan State University) R.R. 1, DeWitt, Mich.

Becker, Robert H. — (University of Nebraska) R.R. 2, Cedar Rapids, Nebr.

Bedwell, Robert L. — (University of Tennessee) 1412 Mitchell St., Humbolt, Tenn.

Beerwinkle, Kenneth R. — (Texas A & M College) R.R. 5, Temple, Tex.

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Blinne, Robert E. — (University of Missouri) 619 W. Essex, Kirkwood 22, Mo.

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Bothager, Jon D. — (Texas A & M College) Box 395, Bremond, Tex.

Brandt, Ray A. — (Iowa State University) Dysart, Iowa

Brust, Kenneth J. — (University of Idaho) ARS, USDA, Tempe, Ariz.

Buchanan, Lorne C. — (Iowa State University) Agr. Eng. Ext. Service, dept. of agr., Dauphin, Manitoba, Canada

Burkhardt, George R. — (University of Missouri) Reid's Trailer Park, R.R. 7, Columbia, Mo.

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Chabica, Edward P. — (Michigan State University 1621 K, Spartan Village, East Lansing, Mich.

Chesness, Jerry L. — (Louisiana State University) 3100 Highland Rd., Baton Rouge, La.

Collins, Wayne G. — (University of Saskatchewan) 110 4th Ave., N., Saskatoon, Sask., Canada

Comer, George H. — (Virginia Polytechnic Institute) R.R. 2, Luray, Va.

Cook, William B., Jr. — (Texas A & M College) R.R. 1, May, Tex.

Corporon, Leo F. — (Iowa State University) College Trailer Park, R.R. Lincoln Highway 30, W., Ames, Iowa

Dahlberg, Franklin L. — (Texas A & M College) R.R. 4, Taylor, Tex.

Daneby, Michael J. — (Cornell University) R.R. 3, Canastota, N.Y.

Darnell, Ernest D. — (Oklahoma State University) R.R. 1, Bluejacket, Okla.

Dimmitt, Arnold K. — (Washington State College) P.O. Box 355, Oak Harbor, Wash.

Dunn, James K. — (Iowa State University) Crawfordsville, Iowa

Eccles, Homer G. — (University of Idaho) Picabo Livestock Ranch, Picabo, Ida.

Fang, Pen Jeng — (Oklahoma State University) 410 S. Hester St., Stillwater, Okla.

Fields, Fred K. — (University of California) 303 Washington St., Santa Fe, N.M.

Fiscus, Douglas E. — (Iowa State University) Management trainee, Cargill, Inc., 200 Grain Exchange, Minneapolis, Minn.

Flynn, Patrick F. — (University of Minnesota) R.R., Regal, Minn.

George, Tommy A. — (University of Nebraska) (SCS) USDA, Bon Marche Bldg., Spokane 1, Wash.

Geyer, Frederick P. — (Purdue University) R.R. 1, Wakarusa, Ind.

Gradwohl, Donald R. — (University of Idaho) R.R. 5, Caldwell, Ida.

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Hall, Glenn E. — (Michigan State University) 755 Beall Ave., Wooster, Ohio

Hart, Royce L. — (Texas A & M College) 918 N. Montgomery St., Gilmer, Tex.

Hetsroni, Gad I. — (Michigan State University) 1548-H Spartan Village, East Lansing, Mich.

Hills, William E. — (University of Missouri) 800 Brookfield Ave., Brookfield, Mo.

Howell, Duane A. — (Iowa State University) John Deere Waterloo Tractor Wks., 1216 Northey, Waterloo, Iowa

Huff, Howard I. — (Rutgers University) Salem Pike, Mickleton, N. J.

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Hurtz, Dennis L. — (University of Nebraska) Wymore, Nebr.

Johnson, Duane R. — (University of Minnesota) R.R. 2, Roseau, Minn.

Kildow, Stanley G. — (Washington State College) R.R. 5, Box 291, Olympia, Wash.

Kiechkner, Lowell H. — (Iowa State University) Engr., (SCS) USDA, Council Bluffs, Iowa

Kriz, George J. — Agr. eng. dept., Iowa State University, Ames, Iowa

Laduke, Gordon E. — (University of California) Jr. engr., California Packing Corp., 215 Fremont St., San Francisco, Calif.

Laflen, John M. — USDA, agr. eng. dept., University of Louisiana, Baton Rouge, La.

Leach, Charles M. — (Virginia Polytechnic Institute) R.R. 4, Staunton, Va.

Lees, Donald L. — (University of Nebraska) Layne-Western, 4430 Western Ave., Omaha, Nebr.

LePori, Wayne A. — (Texas A & M College) R.R. 1, Harwood, Tex.

Lewis, David C. — Res. asst. in irrigation, University of California. (Mail) 646 C St., Davis, Calif.

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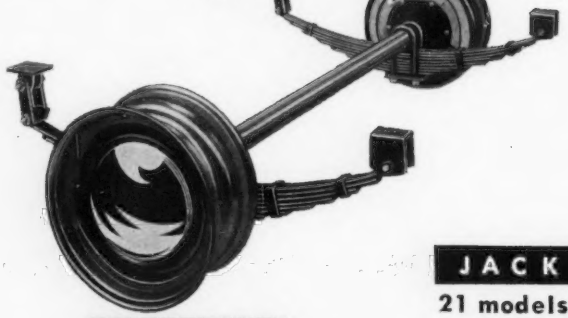

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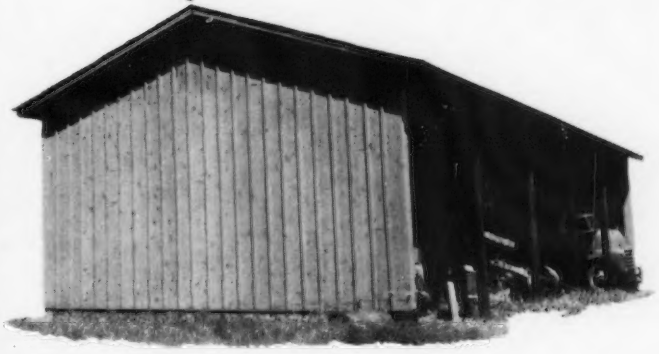

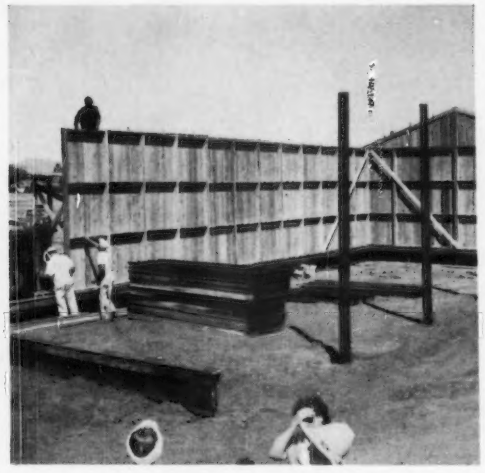

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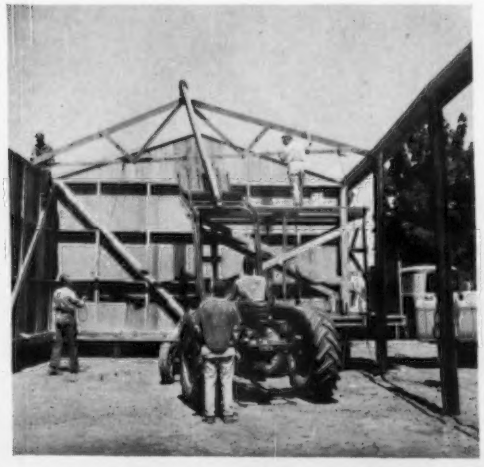

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McCollum, James W. — (University of Missouri) 331 N.E. Crescent St., Peoria, Ill.
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Stiefermann, Charles A. — (University of Missouri) Bonnots Mill, Mo.
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Strane, Laurence R. — (Montana State College) Forsyth, Mont.
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Vongsuri, Sommai — Agr. eng. dept., Oregon State College, Corvallis, Ore.
Walter, Fredrick L. — (Cornell University) 114 Summit Ave., Ithaca, N. Y.
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Wilde, David A.—(University of Saskatchewan) Welling, Alta., Canada
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Wilhelm, Luther R. — (University of Tennessee) R.R. 1, Box 200, Camden, Tenn.
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Wolfe, Robert R. — (University of Wisconsin) 320 Lathrop St., Madison 5, Wis.
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Zaruba, Arlen A. — (University of Nebraska) Cedar Rapids, Nebr.

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Note: In this bulletin the following listings current and previously reported are not repeated in detail. For further information, see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this bulletin, request form for Personnel Service listing.

Positions Open—February—O-4-601, 11-602, 35-605. **March**—O-57-608, 66-609, 83-610. **April**—O-105-612, 111-613, 114-614, 126-617. **May**—O-169-618, 171-619, 187-620. **June**—O-231-621. **July**—O-237-622, 245-623, 656-624.

Positions Wanted — February — W-3-1, 10-2, 15-3, 16-4, 17-5, 5-6, 33-8, 37-9. **March**—W-46-11, 63-13, 62-14, 69-16, 73-18, 74-19, 76-20, 94-21. **April**—W-99-24, 102-25, 96-26, 110-27, 127-28, 12-29, 117-31, 120-32, 121-33. **May**—W-101-34, 140-35, 129-36, 156-38, 175-39, 119-40, 158-41, 170-42, 103-44. **June**—W-190-45, 191-46, 207-47, 208-48, 199-49, 193-50, 213-51. **July**—W-211-52, 221-53, 238-54, 247-55, 239-56, 252-57, 253-58, 254-59, 257-60.

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Graduate Assistantships (2), in power and machinery, farm structures, electric power and processing, or food engineering, in agricultural engineering department of an eastern state university. BS in any branch of enginering or technology. Academic qualifications for graduate work. Thesis research can satisfy departmental duty obligation. Salary $2,730. O-270-625

NEW POSITIONS WANTED

Agricultural Engineer for design, development, research or management in power and machinery, rural electric or product processing field, with manufacturer, processor, or farming operation, anywhere in USA. Married. Age 27. No disability. BSAE, 1960, University of Arkansas. Farm background. Naval enlisted experience 8 years. Available on 30 days notice. Salary $5,000. W-263-61

Agriculturist for research, grain storage, or production in farm structures, long-time preservation and storage of grains, or pest control, with industry or public service, anywhere in USA. Married, Age 44. No disability. BS in agriculture, 1949, University of Belgrade, Yugoslavia, with emphasis on entomology, pest control, grain storage, and agricultural production. Experience in charge of production, small cooperative farms 2 years; production and quality control for Seed and Grain Institute, 6 years; in charge of livestock feed, Veterinarian Institute, 2 years. Available on reasonable notice. Salary open. W-264-62.

Agricultural Engineer to manage retail outlet on large farming operation in Southern US. Married. Age 39. No disability. MSAE in power and machinery, 1955. Farm background. 8 years experience with full line farm equipment manufacturer. Experience in sales, service, and research. Available on reasonable notice. Salary open. W-265-63

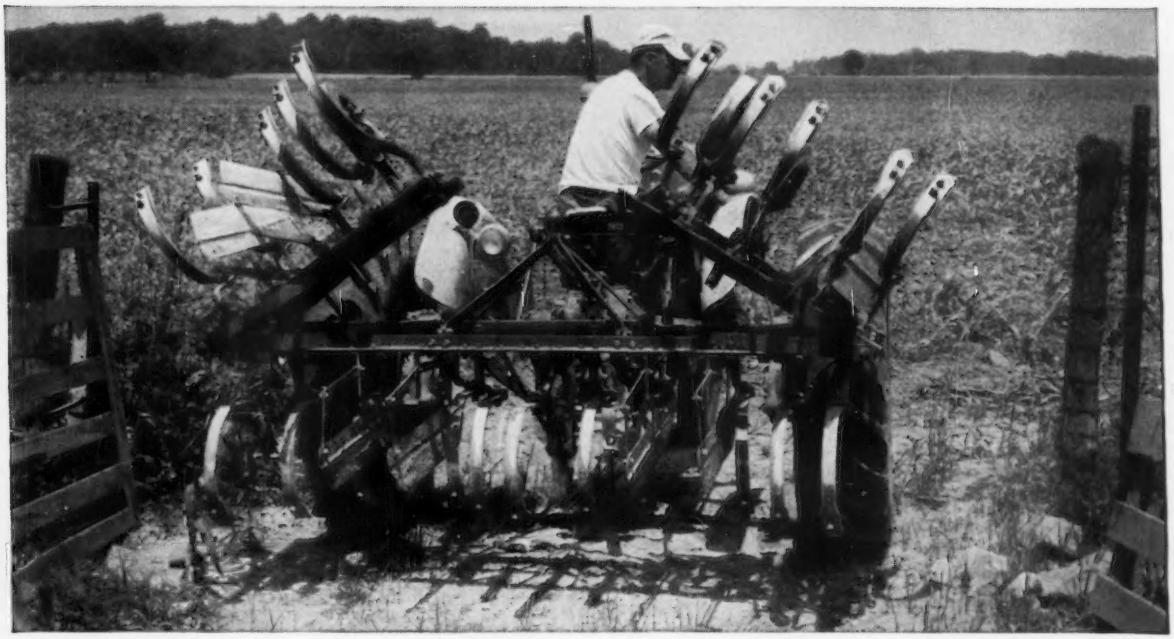
Agricultural Engineer for design, development, research or writing in power and machinery with college, manufacturer or consultant, anywhere in USA. Married. Age 37. No disability. BSME, 1949, Iowa State University. Experience with manufacturer of agricultural and industrial tractors 11 years including 4 years on design of engines, 2 years on experimental stress analysis, and 5 years on general design and development. Military service experience as mechanic. Iowa farm background. Available on reasonable notice. Salary open. W-262-64

IF THE GATE'S TOO NARROW, FOLD THE CULTIVATOR!

With two 4-row cultivators, farmer Henry Poffenberger, of Eldorado, Ohio, can cover 180 acres of corn *twice* in less than four days. However, he had a problem to solve. The cultivators were too wide to pass through his gates.

Widening the gates would have been costly, involving a lot of time and labor. So Henry figured out another answer. He did some cutting, welding and bolting and ended up with a hinged-type cultivator that folds up by pulling one pin when he encounters a narrow gate. His ingenuity not only saved him money, but he also was awarded $100 by a farm magazine for his idea!

This bright idea was a big help to Henry Poffenberger. And so are the neighborly service and on-time deliveries he gets from Texaco Consignee Hubert J. Miller, of Eaton, Ohio. Mr. Poffenberger uses economical Fire Chief gasoline. He, like other progressive farmers, knows that *it pays to farm with Texaco products.*



He built an irrigation pipe carrier

Willis Kaufman (right), farmer near The Dalles, Oregon, needs irrigation to grow 250 tons of cherries a year. He has two wells, one 231 feet deep and one 621 feet, which provide 600 gallons of water a minute. To transport the aluminum pipe around the orchard, he rigged up this carrier, using angle iron and the wheels from an old car.

Willis Kaufman depends on his home-made pipe carrier just as he depends on Texaco Marfak lubricant and other products from Texaco Consignee R. M. Brown (left). He prefers Marfak because it sticks to bearings better. It forms a tough collar around open bearings, sealing out dirt and water. Marfak won't jar off, wash off, melt down and drip out, dry out or cake up.

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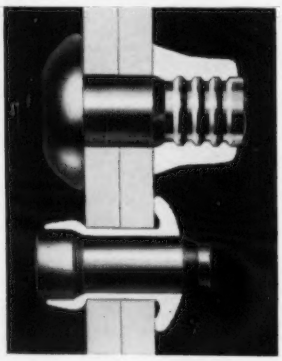

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